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RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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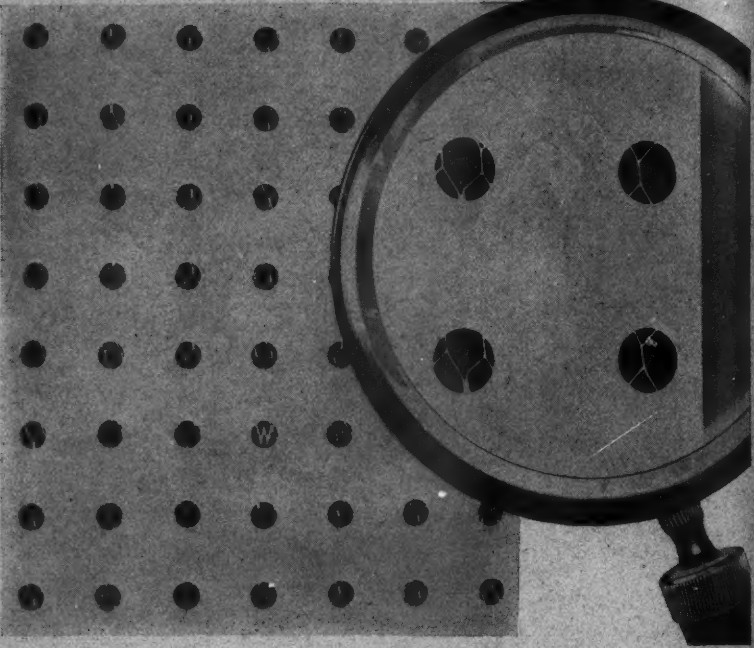
How the test was made

A sheet of lead, measuring 14" x 17" and with half inch holes drilled through it, was mounted 2½" above a 14" x 17" film holder. A piece of wire mesh, measuring 14" x 17", was placed on top of the lead. An X-Ray exposure was made under the following conditions: 25" target film distance; 80 K. V. C.; 10 milliamperes; 5 seconds; no screens.



Can *your* X-Ray tubes pass this test?

THE accompanying illustration graphically demonstrates the amazing detail and contrast obtained in films made with Westinghouse Radiographic Tubes. Note that the black images of the holes in the lead sheet are absolutely round and sharp, and that the image of the wire mesh is clear and distinct. Also note the precise uniformity of detail and contrast extending right out to all four edges of the 14" x 17" film.

No X-Ray tube, no matter how small its focal spot or how great the film-target distance used, can pass this test, unless the tube is so constructed that the radiation reaching the film originates only at the focal spot. Scattered radiation emanating from the anode stem or other internal parts of the tube would destroy this wonderful detail and contrast. Try this test with the tube you are now using—or have your Westinghouse representative show you one of these original test films, together with films produced under the same conditions using other makes of tubes. The comparison will astound you. Westinghouse X-Ray Company, Inc., Dept. E-19, Long Island City, N. Y.

Westinghouse X-Ray

AN INVESTMENT IN A WESTINGHOUSE X-RAY TUBE IS PROTECTED. DAMAGED TUBES CAN BE REPAIRED—OR SALVAGED

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CONTENTS FOR JULY, 1932

All KELEKET Transformers must make good...

A strong statement, but not extravagant when applied to the Keleket "Power-Plus" Unconditionally Guaranteed X-ray Transformer. The continuous satisfaction it has given the profession enables us to say this and stake our reputation upon it.

Only once in a lifetime is it necessary to buy a Keleket X-ray Transformer, identified by the yellow band.

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When we presented the new Keleket line of unconditionally guaranteed "Power-Plus" X-ray Transformers with the yellow band, we issued a challenge. That stands undisputed, so we repeat our challenge.

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That's why we repeat the challenge—"Unconditionally Guaranteed." You be the judge.

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Keleket
X-RAY EQUIPMENT

AS MODERN AS TOMORROW

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THE WORK OF THE NATIONAL AND INTERNATIONAL COMMITTEES ON X-RAY AND RADIUM PROTECTION[1]

By LAURISTON S. TAYLOR, Bureau of Standards, WASHINGTON, D. C.
United States Member International X-ray and Radium Protection Commission

X-RAYS during the past thirty-five years have grown potentially more dangerous. They have increased in penetration, consequently are more difficult to shield. Higher penetration, necessitating higher line voltages, brings with it a greater electrical hazard. Furthermore, the tube currents are higher; hence, stray dosage is heavier.

Of course, we have an advantage over the pioneer X-ray workers in that we know a great deal about the properties of X-rays which they did not, so, by applying well established physical principles, we know better how to protect ourselves. The problem is carefully to determine the sources of danger and either eliminate them or provide protection against them. This is not simple, for it is practically impossible to completely absorb X-rays or gamma rays. We must be content to reduce their intensity to the point at which they are relatively harmless. In doing this we must balance the cost of equipment and ease of operation against the tolerance dose which may be received in a given time without harm.

Since the early years of X-rays, radiologists have recognized their danger and have sought to cope with it. Protection committees of the various radiological societies in this country and abroad have made safety recommendations with undoubted benefits.

These have, however, been limited by the fact that they have been more or less isolated efforts. Different societies' regulations have in some cases conflicted. Sometimes cities or States have made regulations which did not give proper consideration to the radiologists' needs. The underwriters, too, had a set of regulations. As usual, the existence of some impossible and contradictory recommendations has tended toward lack of observance of all. The average radiologist is neither engineer nor physicist and he could not be expected to choose accurately the salient points from among all of the less useful ones. Nevertheless, these many different proposals have had a profound effect on more recent proposals and their value must not be unduly discounted.

In 1928 there was in the United States no generally accepted set of X-ray safety requirements. A recognized safety code has perhaps existed longer in England than in any other country, its formulation directly traceable to a number of deaths from radiation burns several years ago. Germany followed England's suit with a more detailed set of requirements which were somewhat later enacted into legislation. Sweden inaugurated a set of proposals very similar to England's. Other European countries had little or nothing covering the matter.

These national recommendations or requirements had many points of conflict.

[1]Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

Realizing the need of a unified safety code, the Second International Congress of Radiology at Stockholm in 1928 formulated for international use a set of safety recommendations which were based on those of England. This was accomplished only after a number of compromises by the English, United States, and German delegates. At the same time the Congress, recognizing that it was not in a position to adopt final proposals, appointed an International X-ray and Radium Protection Commission with one representative each from England, United States, Germany, France, Sweden, and Italy. The principal purpose of this commission was to study developments in the art of protection in order to improve the general recommendations as developments warranted.

The membership of the International Protection Commission is as follows:

G. W. C. Kaye, England (Honorable Secretary); Stanley Melville, England (Honorable Secretary); I. Solomon, France; R. Ledoux-Lebard, France (Hon.); G. Grossmann, Germany; E. Pugno Vanoni, Italy; R. Sievert, Sweden; Lauriston S. Taylor, United States.

As an outgrowth of the International Commission there was formed in the United States an Advisory Committee on X-ray and Radium Protection to deal with our particular problems and to draw up a set of definite recommendations. These recommendations were likewise to form a basis for proposals made to the International Commission. The Advisory Committee is composed of physicists, radiologists, and engineers, selected by the several medical-radiological organizations and the X-ray equipment manufacturers. Its membership is as follows:

Lauriston S. Taylor, Bureau of Standards (Chairman); R. R. Newell, M.D., and G. Failla, D.Sc., physicist, Radiological Society of North America; H. K. Pancoast, M.D., and J. L. Weatherwax, M.A., physicist, American Roentgen Ray Society; W. D. Coolidge, Ph.D., and W. S. Werner, E.E., X-ray equipment manufacturers; F. C. Wood, M.D., American Medical Association; S. M. Withers, M.D., and C. F. Burnham, American Radium Society.

This advisory committee has recently completed a set of definite safety recommendations for X-rays and high voltage equipment which has been published and is available in reprint form. They have been officially adopted by the American Roentgen Ray Society and the Radiological Society of North America. The Bureau of Standards will use them as a basis for its opinions.

The question of the legal status of these recommendations has been frequently raised. They have none. The Committee feels that none is needed; that legislative enactment tends to stunt development and prevent healthy changes. We are free to admit that our present proposals may require changes in the future as the art develops. We wish nothing to interfere with the freedom for modification. It should be pointed out, however, that lack of legal standing will probably not in any way detract from their legal value. They are a recognized set of recommendations, drawn up by qualified representatives of the art and freely distributed to those interested. A court decision involving X-ray protection would in all probability, for lack of another source, be guided by these recommendations, and persons ignoring them may be held liable for negligence. We shall hear more on this question from Mr. Wanvig, of an insurance organization.

I should like now to make a few comments about the International X-ray and Radium Protection Proposals. The 1928 set was published in this country as "B.S. Circular No. 374" and was also printed in the radiological journals.[2] The 1931 proposals follow the earlier ones except for a few modifications which I will enumerate later.

These international recommendations are purposely kept as simple as possible, serving merely as a guide, about which individual countries may shape their own more detailed proposals.

In formulating both sets of proposals there developed two particularly strong points of dissension. The first concerned the lead thicknesses required for shielding off X-rays of all voltages. The United States representative advocated the heaviest lead protection, while the German held that there was a tendency to over-protect. An average of the demands by the United States and Germany just about met the British requirements, so these were adopted with but slight modification. Since that time some very careful studies by several investigators have indicated that the lead thicknesses proposed by the International Committee were probably sufficient, these values being based on the average tolerance dose as determined in several independent studies. At the Paris meeting the German representative again sought unsuccessfully to reduce lead thicknesses. I might mention (parenthetically) that in the 1931 proposals, the lead protection values were extended up to 400 K.V. X-rays where 1.5 cm. lead protection is required.

The other chief point of dissension was on the high tension aerial height. The German representative wished the stipulation of 7.5 foot height as against 9 feet wanted by most of the other countries. Of course, 9 feet is ideal but frequently impractical. The Committee recognized this but held to the 9-foot height as a condition to be realized when possible. In this country we specify a minimum height of 7.5 feet, preferring to set an absolute limit rather than to recommend an ideal, this being the only instance wherein we dissent from the international recommendations.

I will go over some of the other changes very briefly. Emphasis was placed on the improvement of working conditions, and more exact proposals were made to insure sufficient holidays and more frequent medical examinations for workers.

Recognizing that fluoroscopy presents one of the greatest hazards to the radiologist it was recommended that hand palpation be reduced to the minimum. Two countries even proposed that mechanical palpation be substituted for hand palpation in all work.

A clause was inserted, specially recommending the use of X-ray equipment having the high tension circuit completely inclosed in earthed conductors. This is now possible in a great variety of ways.

Special electrical precautions were likewise recommended for X-ray equipment in anesthetic rooms. While not stated in the proposals, the implication was for the use of equipment enclosed in vapor-proof containers.

The use of non-flammable films was recommended. In case flammable films are used, adequate precautions must be taken in storing them. It so happens that "adequate precaution" is nearly always prohibitively expensive.

Relative to radium protection, the table of lead thicknesses was revised downward; also to include protection for quantities up to 10 grams of radium. The Committee, recognizing that our knowledge of radium protection is very deficient, will lay particular stress on that question in 1934, and toward this end is going to invite the coöperation of other experts in the field. Among these and other changes were several recommendations made by the American Committee in its proposals, so that our views are well represented.

I might cite what I believe is specific evidence of the effect of the international safety recommendations. In the apparatus exhibit at the 1928 Congress, England was the only country exhibiting carefully protected X-ray apparatus. It may be recalled that at that time England was the only

[2]RADIOLOGY, September, 1931, XVII, 542-558.

country having X-ray protection recommendations of long standing and the international recommendations did not exist. As contrasted to this, the apparatus exhibit at the 1931 Congress contained protected apparatus from all countries. The inference is that, with the weight of the international recommendations behind them, the manufacturers followed the obvious course and built their apparatus in accordance with them.

A few words now about the X-ray protection recommendations of the U. S. Advisory Committee. I shall not go into details since the speakers following me will do this, but will emphasize a few of the more important features that particularly concern present-day installations. These recommendations are contained in the "Bureau of Standards Handbook No. 15," which may be obtained from the Superintendent of Documents.

Protective plasters, leaded rubber and the like are considered to be unsatisfactory for providing permanent protection of more than 1 mm. lead equivalent. This limits their use to radiographic work below 75 K.V., which thus permits the use of plasters in the smaller offices but precludes their use for any sort of therapy installations. One of the causes for this restriction is the fact that the protective qualities of plasters fall off rapidly above about 100 K.V., thus requiring for high voltage mechanically prohibitive thicknesses.

Protective glass windows are required to have the same lead equivalent as the remainder of a room. I may point out that in nine-tenths of the installations I have seen, both in this country and abroad, insufficient thicknesses of lead glass are used. For example, a 200-K.V. therapy room frequently has the required 4-mm. lead walls and yet a large window with only 1-mm. lead equivalent—an obvious hazard. Likewise, many fluorescent screens are backed by insufficient lead glass. This common fault is particularly dangerous and yet very readily remedied. In the installation of sheet lead, reasonable care should be used. I know of one installation in which an otherwise satisfactory lead wall for a therapy room was perforated every six inches with a large tar-paper nail. Enough radiation passed through that wall to clearly fluoroscope the hand.

Open tube bowls are not recommended for any sort of installation. Closed bowls may be used for diagnostic and superficial therapy tubes, provided protective sleeves extend down the tube arm a sufficient distance. Deep therapy tubes must be completely surrounded by a protective enclosure. If the tube has a built-in protection, the surrounding enclosure may be reduced by an equivalent amount.

The minimum height of permanent high tension conductors is given as 7.5 feet. It should be emphasized that this applies to meters, stabilizers, cord reels, and cords (when not in use).

For use in anesthetic rooms all X-ray equipment must be inclosed in vapor-proof containers. In this connection it is of equal importance that the operating switches be similarly enclosed.

The Committee gives its unqualified endorsement to the sole use of slow-burning, safety-base films. It furthermore endorses the recommendations of the National Board of Fire Underwriters for the storage of inflammable film already present.

The recommendations close with a set of operating rules for technicians, nurses, etc., which should result in safer and more healthful working conditions.

It is hoped that the recommendations may prove to be of assistance to all workers in the field. In speaking for the Advisory Committee on X-ray and Radium Protection, I may say that it will be very glad to advise the radiologist in solving his general or specific problems relating to protection.[3]

[3]Read before the Radiological Society of North America, Nov. 30–Dec. 4, 1931.

X-RAY PROTECTION FROM THE MANUFACTURER'S VIEWPOINT[1]

By WILBUR S. WERNER, E.E., COVINGTON, KENTUCKY

INTRODUCTORY to this paper, may it be stated that an attempt will be made to express the views of manufacturers in general? Individualism will be avoided.

Throughout the past, there has been a constant desire in the minds of manufacturers to improve and safeguard equipment used roentgenographically. Efforts have been continually directed toward this end. A glance backward to the old induction coils with their "open," or "live" control switches, unsupported high tension wires, unshielded X-ray tubes, etc., will cause appreciation of the tendency toward advancement.

However, inception of the American Safety Committee offered a directed means to promote collective effort which would bring to the foreground protective measures for unified acceptance.

The recommendations presented by this Committee resulted from careful investigations and were based on conservative analytical thought. It is not suggested to the roentgenologist that he suddenly discard his present apparatus, nor is it desired of the manufacturer immediately to disrupt his current production. A reasonable transition period will permit both roentgenologist and manufacturer to bring equipment in use and in production up to the correct standards set by the Committee, without working a severe hardship on either. There is, however, a very human tendency to retard acceptance of new presentations and regulations, particularly when acceptance incurs changes and cost.

Adoption of the Safety Committee's recommendations will add an initial burden to roentgenologist and manufacturer alike; however, the improved conditions resulting from acceptance will be worthy of the effort.

Co-operation between user and manufacturer is indicated to secure the best end-result. At times a manufacturer is requested to make a type of installation which good judgment advises is against the best interests of the user. Ordinarily the requested limitation of protection arises from a desire to economize. Manufacturers also have at times been at fault when designing equipment in keeping in mind a low competitive sales price rather than the utility and safety of the product. This practice has been encouraged by some laymen hospital boards which purchase X-ray equipment on price basis only. This is due to their lack of intimate knowledge of uses and details of equipment, and of types of installations. Correction for this is suggested by giving the roentgenologist final approval on purchases made for hospital use. These last conditions are only mentioned as they offer little stumbling blocks in the paths of roentgenologists and reliable manufacturers in the continuity of advancement of the art toward the ultimate goal.

The manufacturer can and should play an important rôle in bringing X-ray laboratories up to the standards suggested by the Safety Committee. Every effort should be directed not only toward having new designs of equipment conform to the protection recommendations, but the manufacturer should assist the roentgenologist to bring his installed equipment up to the same specifications whenever this is practical or possible.

The design of the equipment is only a part of a good safety program. The manufacturer can further assist by giving correct layout information when new laboratories

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

are planned. Correct protective lining of X-ray rooms, installation of safety signals, cut-out switches on machine room doors, seclusion of inter-connecting cables in conduits, etc., are very important. The manufacturer, in presenting a proposed layout of a laboratory, can incorporate all these features, giving the correct individual specifications for each detail.

In the past, electrical hazards, because they were easily visualized, have been given close attention by manufacturers. Even high voltage and large capacity, shock-proof equipment is being presented at the present time. As a result, there has been a very small percentage of serious injuries from this cause. Protection from stray radiation, however, has not been given the consideration that experience has indicated, and special attention should be directed to this matter by both roentgenologist and manufacturer.

A few of the recommendations of the Safety Committee are presented below.

1. All protective materials should be marked by the manufacturer to show the lead equivalent thickness of the material. For protective materials containing other than lead as an absorbing medium, the voltage at which the equivalent applies should be given.

2. Minimum lead equivalents per voltage are recommended by the Safety Committee.

3. The use of movable protective screens is dangerous and should be avoided.

4. Protective tube inclosures should surround the tube. Open bowls should be discarded.

5. Exposure and treatment rooms should be correctly X-ray-proofed in accordance with the quality of radiation employed. When lead lining is used special care should be given to the overlapping of joints and to the means of application.

6. X-ray and control rooms should be located to avoid dampness and to provide ample ventilation and light.

7. In fluoroscopy, when a tube with exposed high tension parts is used, the tube and its conductors should be shielded with a grounded metal barrier, or its equivalent.

8. Overhead conducting systems should have a normal minimum clearance to ground of seven and one-half feet. Aerial brackets must be able to withstand additional dead weight of 50 pounds.

9. A foot switch should have a rigid shield above the button to prevent accidental closure of the switch by stepping upon it. Furthermore, an auxiliary series switch should be located on the control panel to cut the foot switch entirely out of the circuit when it is not in use.

10. Sparking distance standards are set by the Safety Committee for the purpose of specifying spark-over distances.

11. When a high tension generating unit cannot be installed in a separate machine room, it should be isolated with a grounded barrier, or its equivalent.

12. The Safety Committee especially endorses the use of the slow burning, or safety base, X-ray film, as this film offers no greater fire hazard than ordinary newspaper in the same form.

13. Safety films (cellulose acetate) may be stored as letters are filed. However, nitrocellulose films may be stored only in protected vented fireproof vaults, in keeping with the regulations of the National Board of Fire Underwriters.

In conclusion, may it be stated that, inasmuch as both roentgenologists and manufacturers should appreciate the desirability of use of the protective measures recommended by the Safety Committee, both agencies should mutually co-operate to bring about their universal acceptance.

PROTECTION IN X-RAY THERAPY[1]

By WILHELM STENSTROM, PH.D., Section of Biophysics and Cancer Institute, University of Minnesota, MINNEAPOLIS, MINNESOTA

THE dangers connected with roentgenotherapy have been emphasized so frequently that they are quite familiar to roentgenologists. Even the best informed men may, however, become careless. All too often do we learn of prominent physicians and scientists who have to pay heavy penalties for neglecting to take all the necessary precautions when they are working with roentgen rays. It is, therefore, well to keep up the vigilance and to review, from time to time, the problem of protection.

The different radiologic societies have repeatedly contributed valuable discussions and instructions concerning protective measures. Recently this has culminated in a concise effort to give specific recommendations. An Advisory Committee on X-ray and Radium Protection was formed. This Committee was supported by the Bureau of Standards and their physicist, L. S. Taylor, became its Chairman. The results are published in the Bureau of Standards Handbook No. 15, "X-ray Protection," which can be obtained for ten cents from the Superintendent of Documents, Washington, D. C. The recommendations contained in this book of 26 pages should, of course, be followed as closely as possible, and it is hoped that it will be consulted by all roentgenologists.

Old installations should be rechecked to determine if the protection is adequate and new installations ought to be arranged according to the advice contained in the pamphlet. With such precautions taken, we can feel fairly safe; but we must still remember that nothing is fool-proof and that no construction can prevent accidents. It is also necessary that the roentgenologists and the technicians be thoroughly informed of possible dangers and be always on their guard during work. It may not always be possible to follow in detail the rules laid down, but, by using good judgment, it will be possible to avoid accidents. Without referring to the details, we will take up some of the problems for discussion.

Let us first consider the danger connected with the electric current. The low voltage line carrying current to the control stand and the primary of the transformer is usually considered as offering little danger. This line must, however, be satisfactorily insulated and must be heavy enough to carry the maximum required current. It may sometimes be a temptation to replace a burned-out fuse with a heavier one, but this should not be done unless it is definitely known that the wiring, as well as the machine, can stand the heavier load. The line should occasionally be inspected for faulty insulation and broken or worn wires. This is particularly important if the control stand is being pushed around a great deal. The switches should be covered so that nobody can touch the "live" wires. The reason we usually do not get a severe shock when we touch a low voltage wire is that the contact surface, as a rule, is very small. If the surface is large, the contact good, and one part of the body well grounded, then the shock may be severe enough to cause death.

The high voltage line is so much more dangerous because the electric current there can jump a considerable distance through the air and because enough current can be forced through a very small contact surface to cause severe injury, or death. The only satisfactory way to avoid danger from the high voltage is to have it so arranged during

[1]Read before the Radiological Society of North America at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

treatments that it is practically impossible for anybody concerned to come within sparking distance of any portion of the high voltage line. The sparking distance, as well as the corona, is smaller the greater the diameter of the conductor and the smoother its surface and curves.

The danger of the exposure to X-rays is emphasized by the accumulative effect. Unfortunately we know as yet very little about the extent to which it takes place, as it is different in different tissues. The production of erythemal reaction with divided dosage has been fairly well determined, but other changes in the skin do not seem to take place in the same rhythm. Repeated small dosage, for instance, may produce atrophy, and even necrosis, without any preceding erythema. The danger of too much exposure to the operator is due almost entirely to such accumulation. It has, however, happened in the past that operators sometimes have exposed themselves to such an extent, while studying the behavior of the tube, that serious injuries have resulted from a single or, perhaps, a few exposures. If such a thing should happen with the knowledge now available, it must be considered gross neglect. Injuries to an operator or other persons stationed nearby as a consequence of repeated daily exposure to small amounts of radiation, cannot be guaranteed against, for the simple reason that we do not know how radiation affects the cells and the whole organism.

What is the upper limit of radiation we can tolerate? Small amounts of radioactive material deposited in the body have proved to be quite dangerous. In some instances, the destruction of tissues from their radiation has been great enough to cause death directly. A recent study has shown the frequency of bone sarcoma in a group of radium workers so high as to make it probable that the sarcoma resulted from continued exposure to the rays from the deposit of radio-active substances. All living beings are, however, continuously exposed to very minute amounts of radiation from these elements, and the question has even been raised if such radiation is not necessary for life. Here is a considerable gap in our knowledge and a field open for future research. We have, however, to decide upon what may, for the present, be considered safe. I believe that the body as a whole during a number of years (during the time the person is engaged in this type of work) can safely stand the amount of radiation which, when given at one time, would produce an erythema. In many instances such an exposure has been tolerated without any apparent ill effect. The protection may be considered adequate for the operator when the intensity of the radiation at the point at which he is placed with the machine running is at all times so small that it would require at least 10 years to obtain an erythema dose (or 600 r) with the average number of treatments. In order to obtain such protection, it is necessary to have the treatment room lead-lined and to have the operator outside watching the tube and the patient through a lead glass window.

The precautions necessary to protect the patient at each treatment require primary attention. The screening must be so arranged that no portion of the body outside the field receives more than a small fraction of the dose; as an upper limit we may say 5 per cent of the field dose. It is well to keep in mind that rays are given off from practically every portion of the inner surface of the tube. If the rays coming from the arms of a glass tube are permitted to reach the skin unobstructed, while the radiation from the target is heavily filtered, they may be intense enough to cause considerable reaction. It is evident that the distance from target to the nearest portion of the exposed skin must be checked with greatest care, at least to within one centi-

meter. If the exposure should be given at eight inches target-skin distance when figured for a ten-inch distance, the obtained skin dose would exceed the calculated dose by more than 50 per cent. It is at least as evident that the "wrong" filter may give rise to serious consequences. Many schemes have been devised to eliminate mistakes of this kind. The various filters have, for instance, been marked with different colored bands which are in direct view of the operator during treatments. Each filter may, when in position, close the electric circuit of a corresponding colored light bulb, etc. Such arrangements are of great value. Perhaps the most satisfactory method is the use of a large ionization chamber immediately under the filter. This should then be connected to a galvanometer placed in front of the operator. The readings corresponding to the different filters differ greatly. If the operator writes down the reading during each treatment, a record is obtained which can later be used to check up on the filter, if that should be called for. If a treatment were calculated for 1 millimeter copper filter but were given without any filter at all, the dose at the skin would amount to at least ten times the calculated value.

The current and the voltage must also be checked carefully. It is usually advisable to have two milliammeters in series. If at any time they do not register the same, they should both be tested before treatments are continued. A static voltmeter can be used to indicate any untoward change in the potential, and a sphere gap can be used for the determination of the crest voltage and as a safety valve against sudden rises in the potential. It is important to have the X-ray intensity standardized and, of course, just as important to watch against any intensity changes afterward. Such an ionization chamber as was recommended for checking the filter is of great value as an indicator of any change in the X-ray output. When several "fields" are used in treating a patient, great care must be taken that no overlapping occurs unless this has been taken into consideration. The summation of the dose from the different fields should be determined before the treatments, and the amount of radiation so regulated that overdosage results neither on the skin nor within any part of the body. Charts showing the distribution of radiation in tissues, or substances of approximately the same absorption coefficient for X-rays, are needed for this purpose. It should be kept in mind that it is also a serious thing to give too small a dose, as it prevents the patient from obtaining proper benefit from radiation and may rob him of his only chance to improve.

The danger to the patient from accumulation of radiation must be guarded against. Previous treatments and fluoroscopic and photographic exposures must be taken into consideration. The number of treatments to any one area must be kept within safe limits. It is difficult to determine this limit as it depends upon a number of factors. We consider, as a rule, that four full series of high voltage therapy to a certain area of the body are all that can be given without considerable danger of too much atrophy. Years afterwards such atrophic changes may be followed by necrosis. By a full series we mean such an amount of radiation given within three weeks that, for instance, the skin shows a rather intense erythemal reaction. The interval between two successive series should not be shorter than eight weeks.

Most recommendations for protection are of a general nature; the exact details have to be determined separately for each installation. The thickness of lead (or lead equivalent) needed around the tubes and as lining throughout the treatment room is given for different voltages in the pamphlet

"X-ray Protection." It is evident that a rather thick concrete wall or floor does not require the same thickness of lead covering as a thin wall made of tile or wood. Tables giving the thickness of different types of material which stops the radiation to the same extent as 1 millimeter of lead would be of great value. Such figures vary, however, with the hardness of the rays and should, therefore, be determined for the different potentials employed during treatments (for instance, for 50, 100, 150, and 200 kilovolts). Paragraph 1.15 in "X-ray Protection" reads: "All X-ray protective materials shall be indelibly marked by the manufacturer in such a manner as to readily show the lead equivalent thickness of the material (See Table II). For protective materials containing other than lead to cause the high absorption, the voltage at which the equivalence applies shall be given." This recommendation will, no doubt, receive general adoption in the future and much confusion will thereby be avoided.

Tables of the type mentioned above will, however, still be needed and it is hoped that they will be worked out and made available by the Bureau of Standards. Of course, it is advisable to keep as great as possible the distance between the X-ray tube and those who occupy surrounding rooms. However, distance does not contribute as much to protection from X-rays as is generally thought. Ten meters of air do not absorb appreciably more than does 1 cm. of tissue. The intensity of the harder rays, therefore, falls off approximately in proportion to the square of the distance. Often 50 cm. target-skin distance is used for treatments and the intensity at this distance may, therefore, be used as a standard for comparisons. At five meters' distance the intensity is about one hundredth as much, and at 16 meters' distance one thousandth as much. The intensity ought to be reduced by ten thousand and at 16 meters' distance would, therefore, still be too high if no other protection were used. An X-ray tube near a window might send a dangerous amount of radiation into a nearby building.

In order to find out whether or not the protection is adequate, measurements of radiation intensities in the surroundings of the X-ray tube should be made. The simplest method of testing for stray radiation is to use a fluorescent screen. If this is placed in a box, with an opening for the eyes which shuts out light completely when pressed against the face, a fair sensitivity can be obtained after the eyes have become accommodated to the darkness. The test should preferably be made at night. If fluorescence is noticed, the intensity of the radiation is too great for continued exposure of any person. The photographic method is more sensitive and can be used for quantitative measurements of the radiation. Dental films may be exposed at suitable places, for instance, near the operating stand, in the pockets of the personnel, etc., for one or two weeks. Other films may be exposed to known amounts of radiation directly under the X-ray tube. If all the films are of the same sensitivity and are treated in exactly the same manner, developed to the same extent, etc., it can be assumed as a first approximation that films showing the same density have been exposed to the same amount of radiation. Ionization methods can also be used for such tests if the instruments are sensitive enough. In this respect, probably the Geiger counter offers the best opportunity.

SUMMARY

All individuals concerned in the practice of X-ray therapy should be thoroughly familiar with the dangers connected with their occupation.

The recommendations furnished in "X-

ray Protection" must be followed as closely as possible.

Tests must be made to determine the amount of stray radiation in the immediate surroundings of an X-ray therapy room.

If these three rules are strictly upheld, accidents and injuries due to X-ray therapy will become rare.

Ocean Sediments Have High Radium Content.—Radium is more abundant in the sediments of the deep ocean bottom than it is in land rocks. The deep sediments have more than four times as great a radium content as the granitic rocks on land, and more than ten times as much as land basalts. The deeper the sediments, and the farther they are from shore, the greater their radio-active content.

These are among the facts laid before the American Geophysical Union, at Washington, by Dr. Charles S. Piggot, of the Carnegie Institution of Washington.

The samples of ocean-bottom sediments analyzed for radio-active elements are not at all numerous as compared with the land rock and earth samples similarly examined, Dr. Piggot says; but insofar as any generalizations can be made, the facts are as he stated.

This accumulation of more highly radioactive deposits in the deepest and most remote places in the ocean may be having an appreciable effect on the course of the earth's geological history, he said. For one thing, such deposits can well act as blankets to slow down the escape of the internal heat-energy of the earth.

A number of theories of probable sources of these radio-active deposits have been examined and discarded. Dr. Piggot does not believe that they have been concentrated by living organisms and deposited by the downsifting of their skeletons after they have died. While some organic sediments have high radium contents, he said, on the average the nonorganic red clay sediments are three times as radio-active. Neither is the theory of submarine volcanism, with intense chemical action where water and hot magma are in contact, any more tenable, he thinks. Such action would be more or less "spotty" in its effects, whereas radio-active sediments are found everywhere.

Recognizing that much research yet remains to be done on the question, Dr. Piggot inclines to the belief that the origin of the radio-active content ocean-bottom sediments is to be sought directly in the rocks of the earth's crust. These are worn or broken down into the fine particles that eventually settle on the bottom of the sea, some of them carrying all their original radio-active elements with them, others having a part of the original content removed by chemical processes occurring on the way. Where the sediments are mixed with the remains of minute organisms, Dr. Piggot thinks, these latter tend to dilute rather than increase the total radio-active content.—*Science Service.*

RADIUM PROTECTION[1]

By G. FAILLA, D.Sc., Memorial Hospital, New York City

PART I.—GENERAL CONSIDERATIONS

It is well known that radio-active matter is distributed throughout the earth's crust. In general, the concentration does not vary greatly from point to point, but in certain localities (for instance, where radium ores are found) it may be much higher than the average. The radium content of ordinary rocks is roughly one gram in one million tons, or about one-half million cubic yards of rock. On this estimate, the Empire State Building, weighing 300,000 tons, contains 0.3 gram of radium in its walls and floors. In addition, there is always some thorium present in all rocks.

The presence of radon ("radium emanation") and thoron ("thorium emanation") may be detected everywhere in the atmosphere. It has been estimated that the amount of radon found in the air requires the existence of about one gram of *freely emanating* radium per square kilometer of surface. Since only a small part of the radium in the earth is freely emanating, the amount actually present is much greater than this.

The gamma radiation from these radio-active substances or their products of disintegration, is present everywhere. Furthermore, there is a type of radiation more penetrating than gamma rays (cosmic radiation) which reaches the earth from inter-stellar space. Accordingly our bodies are "bathed" constantly in a rarefied "atmosphere" of radiation which penetrates to the innermost cells. In addition, the food we eat, the water we drink, and the air we breathe contain small amounts of radio-active matter, and the cells in our bodies are also bombarded by radiations of the alpha and beta ray types, which otherwise could not reach tissues at an appreciable depth below the skin.

It is evident, therefore, that living matter can tolerate continuous exposure to a certain intensity of radiation of the type under consideration, which for convenience we may refer to as "ionizing radiation." It may even be that a certain intensity of such radiation is essential to life, or that, at any rate, it facilitates living processes. From a different point of view, the theory has been advanced that the presence of such radiation has played a considerable part in the process of evolution. At least it has been demonstrated experimentally that the number of mutations observed in *Drosophila* may be increased considerably by the administration of X-rays under suitable conditions.

The above considerations, of course, give us a lower limit for the intensity of radiation which can be tolerated continuously by living matter. The upper limit is unquestionably much higher, but is very difficult to determine. It probably varies considerably from one species to another, and among different individuals. For instance, we have at the hospital a canary which has been continuously (day and night) in a beam of X-rays for about five months. The intensity of radiation at the point where the cage is suspended has been increased gradually from 0.018 r per minute to 0.044 r per minute, for reasons which need not be mentioned here. In this time the bird has received about 6,000 roentgens of hard X-rays without apparent deleterious effects. I think all radiologists will agree that the same dose administered to the human body in the same way, would probably be fatal.

[1]Read before the Radiological Society of North America at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

On the other hand, we cannot say that this dose is entirely harmless to the canary, because marked effects may develop later, even if the exposure should end now.

This point should be borne in mind in attempting to estimate the upper level of the tolerance dose for the human being. An individual may be exposed to a large dose of radiation in a period of a few weeks but the harmful effects may not be manifest until some months or perhaps years later. On the other hand, exposure to radiation of sufficient intensity to produce a distinct physiological effect in a few months is not necessarily harmful, because the individual may recover completely if he is no longer exposed to the radiation. Accordingly we must always bear in mind that there is a latent period in the manifestation of radiation effects and that there is recovery from these effects if they are not too severe. It follows, therefore, that the upper limit of the tolerance dose is different under different conditions.

We may now define the safe upper limit of the tolerance dose, or simply the "tolerance dose," as that dose of radiation which experience has shown to produce no permanent physiological changes in the average individual. This is general enough to include all conditions encountered in practice. It should be noted that the term "dose" as used here is not synonymous with "quantity of radiation." It involves particularly the time element. Thus the tolerance dose in the treatment of a patient may be the amount of radiation which, *administered in the course of a few hours,* will produce no permanent skin changes. Or the tolerance dose in the case of a temporary technician may be the amount of radiation which he can receive *during the time he works with radium* without suffering any permanent injury. If the technician is to work with radium permanently or for a number of years, it is best perhaps to speak of the "tolerance intensity" rather than the tolerance dose.

1. LOCAL EFFECTS

In the preparation of radium applicators or the process of applying radium to a patient, the hand of the operator is necessarily the part of the body which is closest to the radium. Consequently the hand, and particularly the fingers, will always receive much more radiation than any other part of the body. It is necessary, therefore, to consider only the hands for the local manifestations of exposure to radium.

(a) Individuals Exposed to Radiation for an Indefinite Period of Years.—This refers to the radiologist or surgeon using radium in his practice, who will, presumably, continue to do so indefinitely, and also to physicists and technicians who intend to work with radium permanently.

It is difficult to give a definite estimate of the monthly dose which the fingers can receive over a period of years without showing radiation effects. As a matter of fact, all persons who have worked regularly with appreciable amounts of radium for more than two years show some definite skin changes in their fingers. Unless the individual has been very careless, however, these changes are not permanent nor very marked, and in general they would not be noticeable some years after the exposure to radium ceased.

On our assumption that the individual is to continue his work with radium, it is important to know whether further exposure of the same degree will gradually aggravate the conditions, or whether a sort of "equilibrium" is reached at a certain time, beyond which the condition of the skin remains stationary. These questions cannot be answered categorically for several obvious reasons. However, we may approach the problem from a different angle and get some definite information of practical value.

The writer has been associated with the Memorial Hospital since 1915, during which time he has had the opportunity of observing many technicians who have handled radium for various periods of time. From 1914 to 1917 the Hospital's supply of radium gradually increased to four grams, 3,650 mg. of which was placed in solution for the production of radon. The routine manipulations in the collection, measurement, and distribution of the large supply of radon are considerable, and require special precautions. In 1927 the Hospital acquired four additional grams of radium for use in a pack. The experience acquired during the last sixteen years under these conditions may be used as a guide in formulating certain general conclusions.

The first local effect manifests itself as a reddening of the skin of the fingers near the nails. Later the nails may assume an unusual curvature which, in certain individuals makes the nails slightly concave upward and in others a little more concave downward than normally. Still later (with continued exposure), the nails become somewhat brittle, and have a tendency to crack under slight strain. The skin at the end of the index finger and thumb (which always receives much more radiation than any other part of the hand, particularly through carelessness) becomes somewhat leathery and may lose its characteristic ridges. Finally keratoses may appear.

We have had technicians who have remained with us from a few months to several years. Many of these have come back at intervals for friendly visits and we have had the opportunity to examine their hands for several years after they left the Hospital. We have found that recovery takes place slowly, the time required for a return to normal depending on the degree of effect initially present, the type of skin (whether moist or dry), and the type of manual work done in the interim. Technicians who had developed keratoses have shown definite radiation effects several years later, but there has always been a distinct improvement with time.

Although some technicians show radiation effects sooner than others, it is difficult to attribute this definitely to a difference in sensitivity. Some are certainly much more careless than others. We have had no evidence of any idiosyncrasy to radiation. Since skin tends to become dry under the influence of radiation, a moist skin is an asset. It is important to note that, barring sheer carelessness on the part of the technician, the skin of the hands undergoes these changes very gradually. Furthermore, we have had no technician whose irradiated skin became worse after leaving our employ; on the contrary, there has always been an improvement.[2] It follows, therefore, that the condition of the skin of the fingers may be used as a practical criterion for the protection of technicians from the *local* effects of radium rays. As a safe rule, we may say that if at the end of two years the radiation effects on the hands are limited to a slight reddening and shiny appearance of the skin around the finger nails, the technician may *probably* continue to work with radium indefinitely under the same conditions, *insofar as local effects are concerned.* If gradually more marked effects appear, the technician should decide to give up radium work, either permanently or for a number of months. In view of the slowness of recovery from these local effects, a vacation of reasonable length is of little benefit.

It may be well to emphasize at this point the assumptions which underlie the above conclusion. In the first place, it is assumed that the technician's hands are exposed practically every day and that the quantity of radiation received by the fingers is about the

[2]Since we have not seen *all* technicians after they have left our employ, this statement is based on the condition of the skin of those we have seen and the assumption that, if any complications had developed, we would have been so informed.

same every day. The daily dose is, then, so small that at the end of two years the only visible skin change is a slight reddening and shiny appearance of the skin around the finger nails. *Continuing to work under these conditions,* there will be no sudden change in the skin reaction and one can tell (long before the danger point is reached) whether the skin is gradually getting worse. At the end of two years, enough time has elapsed for the establishment of a certain equilibrium involving the accumulation of daily doses, the latent period, the rate of recovery, and the degree of effect present. Our experience with effects produced under exactly these conditions is too limited to permit us to state that such equilibrium is permanent, but we can say definitely that if it changes, the change is very gradual when the rate of exposure remains the same as during the preceding two years. Hence it is safe to use this as a criterion of protection.

The radiologist who, from the nature of his work, must handle radium for an indefinite period of years, should be extremely careful *from the very beginning* and at all times. The novice is almost always careless and somewhat reckless. Only too often the realization of danger comes after irreparable damage has been done to his fingers. With the knowledge available at present, this is entirely inexcusable. The average radium therapist can arrange his work and technic in such a way as not to exceed the safe limits of exposure of his fingers.

(b) Individuals Exposed to Radiation for a Definite Period Only.—This refers to technicians, assistants, and internes who are required to handle radium for a definite period not exceeding one year, and who do not plan to work with radium afterwards.

In this case the exposure can be considerably greater than in the previous one, without danger of permanent local effects. Again, it is difficult to say just how far one can go. Obviously the criterion of slight reddening and shiny appearance of the skin around the finger nails at the end of two years cannot be used in the case of individuals employed for less than one year. As a working rule we may say, however, that the same degree of effect appearing at the end of five or six months' exposure indicates that the (temporary) technician can safely continue to work with radium *under the same conditions* for an additional six months, so far as *local effects* are concerned. The italicized parts of the above statement are very important. A temporary technician near the end of his term may feel that it is no longer necessary for him to be very careful. Or he may be required to handle more radium, due to changes in technic, increased radium supply, etc. In these cases he is no longer working under the same conditions as previously, the rate of exposure is greater, and one cannot predict what local effects may develop later. It will be seen presently that the local effects of radiation are not necessarily the controlling factors in deciding whether or not a technician may safely continue work with radium. What has been said so far applies only to local effects.

At this point it may not be amiss to recall what the consequences of local over-exposure may be. Throughout the world there have been numerous radiologists and technicians who have lost their fingers, arms, and finally even their lives from over-exposure to X-rays in the early days. There have been several who have run the same course due to over-exposure to radium rays. A recalcitrant X-ray or radium "burn" is very apt to become malignant. Fortunately, however, this does not happen (at least it has not happened in the past) unless there is first an actual breakdown of the tissues following long-continued exposure to radiation. The breakdown need not necessarily be spontaneous, but may be brought about

by mechanical injury of the over-irradiated tissue, which has a low vitality and a tendency to become infected.

In view of the risk involved, it is the personal opinion of the writer (who is a layman) that a finger with a refractory radium "burn" which shows no tendency to heal six months after its inception, should be amputated without further delay. Amputation may be desirable sooner if the "burn" tends to progress. In any case, enough tissue should be removed to insure prompt healing of the operative wound. The tissue removed should be subjected to a careful histologic examination.

2. GENERAL OR CONSTITUTIONAL EFFECTS

The gamma radiation of radium is so penetrating that a block of lead 25 cm. thick is unable to stop it completely. To be sure, the intensity of the transmitted radiation in this case is extremely small, and certainly below the tolerance limit, even if the amount of radium behind such a shield is large. But in practice it is impossible to carry out manipulations with radio-active substances without being exposed to gamma radiation of appreciable intensity. Lead screens of practical dimensions, and distance from the source, help tremendously in reducing the intensity of radiation, but nevertheless the operator's entire body receives some radiation.

The physiologic changes brought about by continuous exposure of the entire body to radiation are rather obscure. It is definitely known, however, that the blood picture changes, and that the white count in particular is a rather sensitive index. Extreme over-exposure in a few cases has resulted in the development of anemia or leukemia which subsequently proved fatal. Thus the complications which may be brought about by constitutional effects are apt to be much more serious than any local burn; hence, much greater care must be exercised.

The local effect on the fingers of a technician cannot be used as a criterion of the degree of general effect. A very careful operator will show no skin changes in his fingers for a long time, but the protective measures against general irradiation in the laboratory or office may be inadequate and the "body dose" will then exceed the tolerance limit in a rather short time. This statement should not be taken to imply that the body dose which a technician receives is independent of the care he exercises in handling radium. A careless operator will obviously get more radiation, both locally and throughout the body, but he is more apt to show local effects first. On the other hand, no matter how careful a technician may be, if he is required to stay regularly in the vicinity of radium with insufficient protection, he will eventually show some constitutional changes.

In general, blood counts are not very satisfactory; variations may be introduced by the technic employed. Normal fluctuations of considerable magnitude are always present over a period of time. The count may change according to the hour of the day when it is taken (*e.g.*, before or after a meal). Furthermore, the absolute white count of normal individuals varies within wide limits. Six thousand white cells per cubic millimeter may be normal for one individual, and nine thousand for another; accordingly, it is impossible to set a fixed lower limit for the white count of radium workers as a danger signal. Nevertheless, under proper conditions and wise interpretation, the blood count can be used as a safety criterion.

With our present knowledge of protection, and the amounts of radium usually available, it is not likely that a technician will receive too large a body dose in a few months. If blood counts are made *before he is employed* and every month subsequently, always under the same conditions (same

technic, hour of day, etc.), one can obtain a fair idea of what constitutes a "normal" blood count for the individual under consideration, before radiation changes may be expected to be present.

In interpreting the results of the blood tests, many factors must be taken into account, but if there is a definite trend downward for the white count over a period of a few months, the technician should be subjected to a thorough physical examination. His working conditions should also be investigated. What steps should be taken after this depend on the findings and on a number of circumstances.

If several other technicians working under the same conditions have not shown like blood changes in the same or longer periods of time, the drop in the white count is probably due to causes other than exposure to radium. The physical examination and the blood count as a whole may reveal the cause. If no plausible explanation can be found, it is safest to assume that the radiation is at least partly responsible for the changes noted, and the technician should then refrain from working with radium[3] for a month or longer to see whether or not the blood count returns to normal quickly. During this period it is desirable to have blood counts made every two weeks, in order to obtain a better average. The writer has no definite knowledge of the time required for the white count to return to normal after it has been lowered by exposure to radiation. This must depend on many factors, and particularly on the period of time during which the technician has been exposed to radiation (whether months or years). At any rate, a vacation of a few weeks usually is not sufficient.

Judging from the number of persons throughout the world who must have been over-exposed since radium has been used extensively, and the small number of casualties from constitutional effects, one may conclude that the human body is capable of withstanding considerable amounts of radiation over a long period of time. Here again a sort of equilibrium may be established, after a certain time, involving the accumulation of daily doses, the latent period, the rate of recovery, and the degree of effect present. Whether such a state of equilibrium can exist when the white count is definitely lower than the normal value, without impairment of the vitality of the individual, is not known. It is really a question of the significance of a low white count brought about by exposure to radiation. The writer (a layman, as mentioned above) is of the personal opinion that a *slightly subnormal* white count due to exposure to radiation, does not connote the same degree of lowered vitality that a similar condition indicates in non-irradiated individuals. For instance, radium technicians with a depressed white count do not seem to be subject to colds to any greater extent than other persons working under analogous conditions. But in view of the lack of definite information on this point, the seriousness of the possible complications, and the relative ease with which sufficient protection can usually be provided, there is no reason, from now on, for allowing the white count of a technician to become definitely subnormal. With careful blood tests made every month, it is not difficult to detect the first signs of a downward trend in the white count, erring on the side of safety if in doubt.

In the case of a radiologist or a physicist who cannot readily drop his work with radium, the question of constitutional effects is extremely important. He should ascertain from the start that he is working under the proper conditions to insure safety. The blood count criterion may not be delicate enough in this case, although there is no

[3] It is assumed that there is no possibility of simultaneous exposure to X-rays. If the technician's duties include work with radium and X-rays, it will be well to check up also the X-ray protection in the laboratory.

evidence to the contrary. For this reason it is very important to have some definite knowledge of the tolerance intensity under these conditions (irradiation of the whole body during a period of years). Some valuable conclusions may be drawn from our experience with the four-gram radium pack at the Memorial Hospital.

3. ESTIMATION OF TOLERANCE INTENSITY

The pack and the protective measures provided have been described in detail in a previous publication (1). For our present purpose we may recall that the radium is surrounded by 10 cm. of lead, effectively limiting the beam of gamma rays to be utilized. Means are provided for "shutting off" the beam while the pack is being adjusted to the patient. Heavy lead plates are distributed in tactical positions for the purpose of confining the scattered radiation. The pack is in use twenty-four hours a day, and three technicians, each on eight-hour duty, attend to it. The technician stays in an adjoining room at a distance of about 5.5 meters from the radium. One technician has been in constant attendance since April, 1927, another since September, 1928, others for shorter periods. There have been some fluctuations in the blood counts of these technicians within normal limits. No detectable trend in either direction has been noted. It may be inferred, therefore, that the intensity of gamma radiation to which they have been subjected during the elapsed time (a maximum of four and one-half years), is below the tolerance limit.

It is possible to determine this in a rather simple way (2). The method has been described by Mrs. Quimby, and the details need not be repeated here. The technician carries a photographic film continuously for a number of days. The amount of blackening is then compared photometrically with that of a series of films exposed to known amounts of radiation, and developed simultaneously with the test film. In this way it is possible to determine the amount of radiation which is responsible for the blackening produced on the technician's film, and, therefore, the average intensity of radiation to which the technician is exposed. It is very important to note that the same quality of radiation must be used in making the comparison standards, as reaches the technician. If the standards are made by exposure to X-rays, large errors are introduced. For instance, using ordinary deep therapy X-rays in making the standards, the intensity of gamma radiation to which the technician is exposed appears to be about one-tenth of what it actually is. As an additional precaution, all films used should be cut out of the same large film and should be developed simultaneously under the same conditions.

This test has been made by Mrs. Quimby in the case of our radium pack technicians on two different occasions, separated by an interval of two and one-half years, the two determinations checking within 5 per cent. While such a close agreement is probably accidental, we may say with considerable assurance that the method is certainly sufficiently reliable for all practical purposes. The results show that these technicians receive approximately 0.001 of a threshold erythema dose per month. In order to avoid any possible misunderstanding it may be well to add that the threshold erythema dose taken as our unit *corresponds to 600 r of X-radiation.* In view of the uncertainties still existing in the measurement of gamma rays in roentgens, it is best for the present not to express quantities of gamma rays in terms of the international unit of X-radiation.

As already stated we have had two technicians who have been exposed to this intensity of radiation for four and one-half and three years, respectively, without showing any blood changes. It is probable,

therefore, that the human body as a whole can be subjected to this intensity of gamma rays indefinitely without showing any deleterious effects. It may be that a considerably higher intensity would also be harmless, but we have at present no very definite data to support this view. Accordingly, it is preferable to use the above value of 0.001 threshold erythema dose per month as the tolerance intensity of gamma rays to which a technician can be exposed continuously for a number of years. It is best in this case to speak of a "tolerance intensity" instead of a "tolerance dose" because we are considering technicians, physicists, and radiologists who expect to work with radium for an indefinite period of years, perhaps a lifetime. If the exposure is limited to one or two years, the intensity can undoubtedly be much greater.

Recommendations as to the value of the tolerance intensity in the case of X-ray workers have been made by different investigators. Mutscheller (3) and Sievert (4) suggest 0.01 erythema dose in 30 days. Barclay and Cox (5) recommend 0.0084 and The Dutch Board of Health (6), 0.002 erythema dose in one month. Bouwers and van der Tuuk propose not more than 0.01 erythema dose per month. These figures are considerably higher than the one advocated by us for gamma rays. The actual intensities are probably still higher than the figures indicate, on account of the uncertainty of the erythema dose which was adopted by some as the unit. In our case the unit is the *threshold* erythema dose, which, as already stated, corresponds to 600 r of X-radiation.

It is conceivable that the human body can tolerate a higher intensity of X-rays than gamma rays, especially if the measurements are made on the surface of the body. On account of the greater penetration of gamma rays, the internal organs would receive more radiation than in the case of X-rays, assuming equal intensities at the surface. The difference, however, cannot be very marked unless gamma rays are differentially more active than X-rays with respect to some body tissues. Since protection from ordinary X-rays can be provided much more readily than in the case of radium, we would suggest that the same tolerance intensity of 0.001 threshold erythema dose per month be used in both cases. This applies to the protection of radiologists, physicists, and technicians permanently engaged in radium or X-ray work, insofar as constitutional effects are concerned.

4. SELECTION AND SUPERVISION OF TECHNICIANS

Before employing a technician for radium work, a complete blood count should be made. If there are any abnormalities which cannot readily be accounted for,[4] it is best not to employ him. Individuals in good physical condition should be given preference. It might be well also to consider the nature of previous employment. A boy who is accustomed to working out-of-doors is apt to show some blood changes after being confined in a laboratory, whether he handles radium or not. The applicant who has led a sedentary life and is in good physical condition might be given preference.

The prospective technician's hands should be examined carefully with the idea of estimating (1) the quality of the skin, and (2) the care he takes of his hands. A moist, pliable skin is to be preferred. A delicate skin is not so suitable for radium work. Dry skin with a tendency to crack or skin with warts should be avoided. A man whose hands show signs of abuse (cuts, cracks, grease from handling machinery, etc.) should not be employed. He is apt not to take proper care of his hands under any

[4]An applicant may have a cold, in which case the white count may be somewhat high. If such is the case, he can be employed tentatively, but another blood test should be made two weeks later and at the end of one month, to determine whether he is suitable.

circumstances. There does not seem to be much difference (if any) in skin sensitivity so far as the hands are concerned, between "fair" and "dark" individuals. Perhaps a dark skin is preferable.

Manual dexterity is a great asset to a radium technician, since the more rapidly all manipulations are carried out, the less the exposure. It is difficult to predict from an interview just how adept the technician will prove to be. The training and previous occupation of the applicant, as well as the career he wishes to follow, may be used as a basis. One who has had some experience can usually pick out at a glance the awkward, slow, and careless individual. The reverse is more difficult, but, at least, one can avoid selecting the worst.

Before the technician is employed he should be told very definitely about the possible dangers of radium work. We always follow this procedure, and it is only rarely that the applicant decides not to accept the position. Permanent employment should never be promised. In fact, it should be definitely stipulated that the technician is to leave if for any reason the employer decides that he is not suitable. Similarly, the technician should have the privilege of leaving at any time, but should give notice of his intention to do so two weeks in advance. A technician who wishes to change his occupation should not be induced to stay. He is apt to be dissatisfied later.

After the technician is employed he should be instructed thoroughly regarding the procedure to follow in order to reduce to a minimum the exposure in carrying out the required manipulations. Usually, close supervision is necessary in the beginning to make sure that he is taking full advantage of the protective measures provided in the laboratory. It is essential to impress the technician with the importance of distance, rapidity of manipulation, and shielding.

Frequent examination of the technician's hands should be made, at least during the first six months. There should be no evident skin changes in this time. If there are, steps should be taken to determine the reason and then act according to the plan previously outlined. Technicians should be instructed and urged to take proper care of their hands, especially in winter. A liberal use of ordinary "hand lotion" is very desirable. Lanoline rubbed into the skin at night seems to be excellent, particularly for dry skin.

Complete blood counts should be made every month and the data should be filed for a permanent record. We have found it best to let our technicians see the results of the blood counts. In this way they know just what is going on, and they are free to consult their family physician for advice, in case there is any doubt in their mind. A complete blood count consists of the following determinations: Hemoglobin test, red, white, and differential counts, the latter including percentages of polymorphonuclear cells, small and large lymphocytes (separately), eosinophils, and basophils. The first indication of radiation effect is given by a drop in the white cell count below the normal average for the individual under consideration. Later, but only in some instances, the differential count may show some abnormality. That is, the percentage of polymorphonuclear cells may be lower, and the percentage of small lymphocytes correspondingly higher, than in previous counts. Whether this change can be attributed to radiation is not definitely known. At any rate, its appearance should be taken as an indication for greater caution and an investigation of the technician's physical condition. The blood count should be repeated immediately to make sure that there has been no technical error, and also in about two weeks' time, to determine whether the effect persists. In the latter case the technician should be relieved of his duties temporarily or permanently, depending on the results of

subsequent tests. If at any time the white count shows a definite trend downward, the steps previously outlined should be taken.

Permanent radium technicians should have six weeks' vacation a year, preferably four weeks during the summer and two weeks in winter. They should be urged to spend as much time as possible out of doors, both during their vacation periods and after working hours. Rooms in which radium manipulations are carried out should have outside windows, or should be properly ventilated. A suitable room or space should be provided where technicians may spend their time when they are not handling radium; this should be located as far as possible from rooms where radium is stored or patients are treated.

It is difficult to state the number of technicians that should be employed to handle a certain quantity of radium. A great deal depends on (1) the therapeutic technic employed, (2) the number of patients treated for whom applicators must be prepared, (3) the protective devices employed, (4) the permanency of the technical personnel, and, of course, (5) the amount of radium available. It is always preferable to have only temporary technicians for the bulk of the work. If several technicians are necessary, one may be employed permanently to supervise the work of the others and to carry out some of the more difficult manipulations.

If the safety criterion for local and constitutional effects given in this paper are followed, the dangers of radium work can be avoided. It should be noted that no reference has been made to the so-called "radium poisoning" which has attracted considerable attention in recent years. The reason for this is that there is no such danger at all in the handling of radium which is *sealed* permanently in metal containers. "Radium poisoning" is due to the slow ingestion of minute quantities of radio-active materials. Radium used for the treatment of cancer is always in sealed containers, and there is no possibility of ingestion by the technician. The only danger to be guarded against in this case is from the effects of over-exposure to the radiations emitted by radium.

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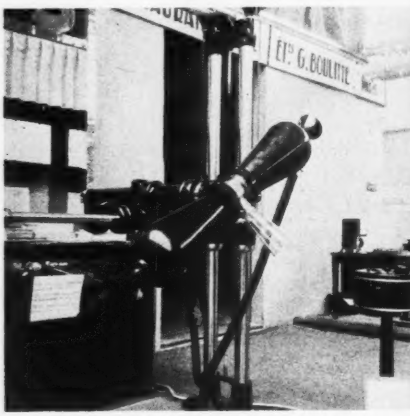
PROTECTION IN DIAGNOSTIC ROENTGENOLOGY: AVOIDING THE DANGERS OF X-RAY EXPOSURE AND HIGH TENSION SHOCK[1]

By W. EDWARD CHAMBERLAIN, M.D., PHILADELPHIA
From the Department of Radiology, Temple University Medical School

THERE is no essential theoretic connection between protection against X-ray exposure and protection against high tension shock. Let us, therefore, consider these two matters quite separately, although it will shortly appear that in practice there are many points of contact between the two problems.



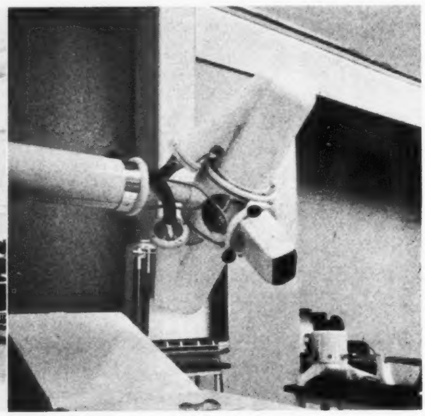


Fig. 1 (*left*). A Metalix "autoprotective" tube is made shock-proof by enclosure in this metal shield. Air, bakelite, and rubber enter into this design. Anode cooling is by means of water, pumped through the anode (insulated) cable. This design may be had in various sizes, according to voltage requirements (cf. Fig. 4). All sizes are perfectly flexible and very compact, and, owing to the fact that the built-in X-ray shielding of the Metalix tube is ample, and is obtained with a minimum mass of lead, close to the X-ray source, the total weight of this shock-proof assembly is remarkably low. Originally designed for therapy, this design is now being manufactured for diagnostic work.

Fig. 2 (*right*). A ray-proof and shock-proof tube shield of recent European design in which perfect flexibility is combined with remarkable compactness. A novel method of preventing the accumulation of excessive negative charges upon the inner surface of the cylindrical glass vacuum chamber has enabled this manufacturer to enclose his tube in a close-fitting porcelain jacket. The outer surface of this porcelain jacket is metalized and grounded. The high tension is admitted by way of rubber-insulated cables. The anode cable carries tubing through which oil is pumped for anode cooling. The use of oil for this purpose greatly simplifies the insulation of the cooling system.

BIOLOGIC EFFECTS

There is a difference of opinion as to the necessity for drastic protective measures against the biologic action of X-rays used in diagnosis. Some hold that the quantities and qualities of these rays are such as to render drastic protection unnecessary; others feel that it is impossible to overdo this type of protection—that no avoidable exposure should be tolerated.

Our own opinion is colored by the unfortunate experience of having had one of our best and most efficient technicians develop an anemia which made a change of vocation necessary. Most of this technician's work was done in a radiographic room which was

[1]Read before the Seventeenth Annual Meeting of the Radiological Society of North America, at St. Louis, Nov. 30–Dec. 4, 1931.

rather small. The operator's booth carried the conventional "4-pound lead" walls, with an excellent lead glass window, but there was no roof. The back wall of the booth was of wood, glass, and plaster. After the damage had been discovered, we readily established the fact that, when the X-ray tube in this room was excited, a considerable quantity of X-rays entered the operator's booth by being scattered back from the ceiling and the rear wall of the booth.

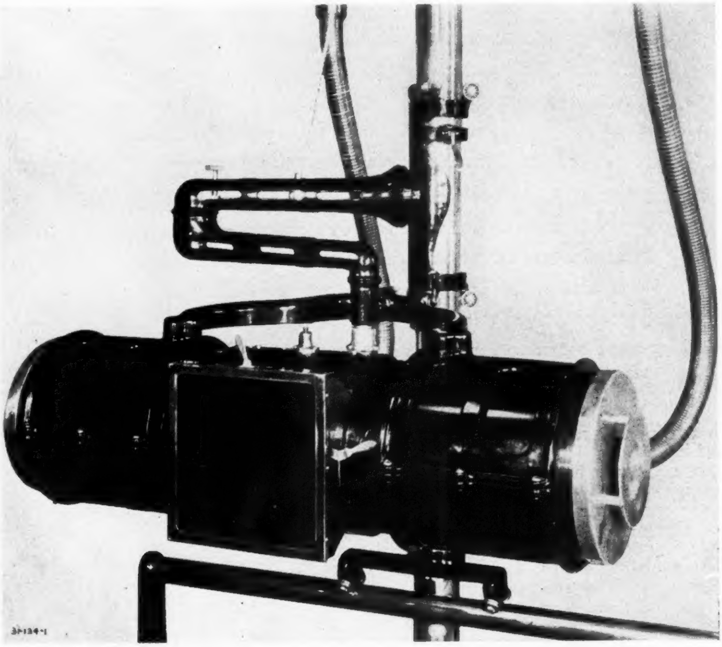


Fig. 3. This recent American design consists essentially of a grounded metal drum, to which the high tension is conducted through ground-shielded, rubber-insulated cables. Ample air space and efficient ventilation enable the use of radiator tubes. For old style X-ray tubes this drum must contain lead shielding, making its weight rather formidable. Used with "autoprotective tubes," such a shock-proof shield need not be so heavy. Note the shutter handles, which control shutters for fluoroscopy.

The protection, which was thus proven to be inadequate, was quite the equal of the average conventional installation. Only after a painstaking study of all the data could we be convinced that the technician's anemia was really caused by X-rays. After we had satisfied ourselves that the protection was inadequate, we made the following changes: a roof of 4-pound lead was added to the operator's booth. The back wall of the booth was covered with lead. The Coolidge tube in its conventional "open lead glass bowl" was replaced by a Metalix "autoprotective" tube. These changes cut down the radiation reaching the operator's position to a barely measurable fraction of its earlier value.

It is obvious that we believe in the greatest possible care to avoid every unnecessary

Fig. 4. A Metalix (autoprotective) tube is completely enclosed within this grounded metal shield (cf. Fig. 1). A small air blower cools the anode radiator. The high tension conductors are rubber-insulated and are enclosed within grounded flexible metal shields. Recent developments along these lines have made it possible to build such ground-shielded rubber-insulated cables for any voltage which could conceivably be required in diagnostic roentgenology. Even therapy voltages have been successfully dealt with.

exposure of patient, technician, and physician. For the sake of brevity, we shall simply list the various measures which have proven of value toward this end.

PROTECTION OF PATIENT

1. *Proper Filters.*—It is easy to establish experimentally that, for each radiographic procedure, a certain definite thickness of filter (usually aluminum) can be used in the beam without noticeable effect upon the density or contrast of the resulting roentgenogram. By using such an optimum degree of filtration, we are cutting the biologic effects upon the patient down to a minimum.

2. *Proper Cones.*—Too often one sees the entire patient "in the beam" while a 2-meter chest film is being exposed. Proper coning will cut down the biologic effects upon the patient, as well as the scattered X-

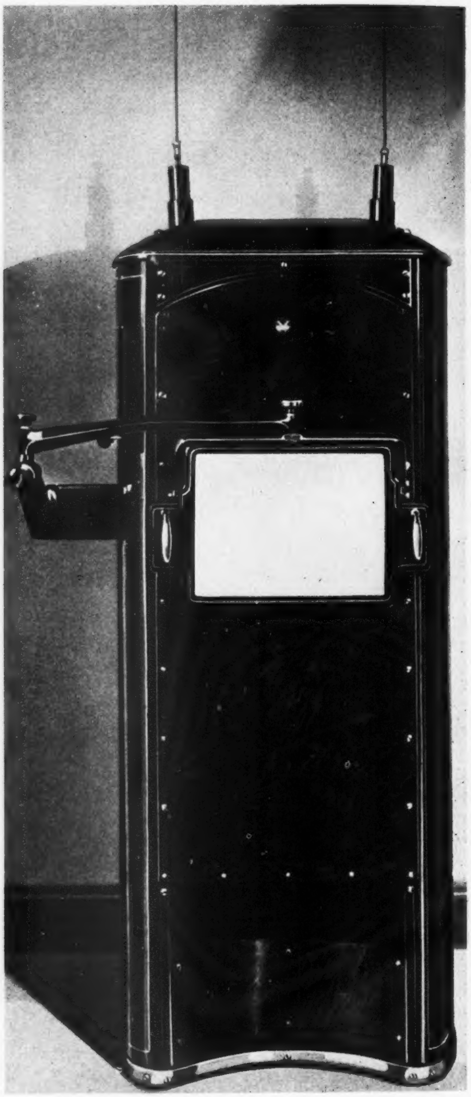


Fig. 5. This recent product of a well known American manufacturer shows how readily the ordinary vertical fluoroscope can be made entirely shock-proof. In this unit, the tube, cord reels, and conductors are all enclosed in a metallic shield or housing, which may also contain the transformer, if desired. The high tension "masts" are used when this fluoroscope is connected to an external source of high tension.

rays in the room, incidentally leading to some improvement in the roentgenogram.

3. *Proper Enclosure of the X-ray Tube.*—The closed lead glass container is much better than the open tube bowl. Best of all are the "autoprotective" tubes such as the Metalix, in which lead sleeves and electrodes are arranged to allow no important amount of ray to leave the tube except in the direction of the useful beam. "Autoprotective" tubes and devices of American manufacture, which have just been announced, give promise of being equal to the best.

4. *Maximum Feasible Distances between Patient and Tube.*—A moment's calculation will prove to anyone that, along with the decrease of distortion in a teleroentgenogram, there is a decrease in skin effect for unit film density. Especially in fluoroscopy has this distance factor been neglected.

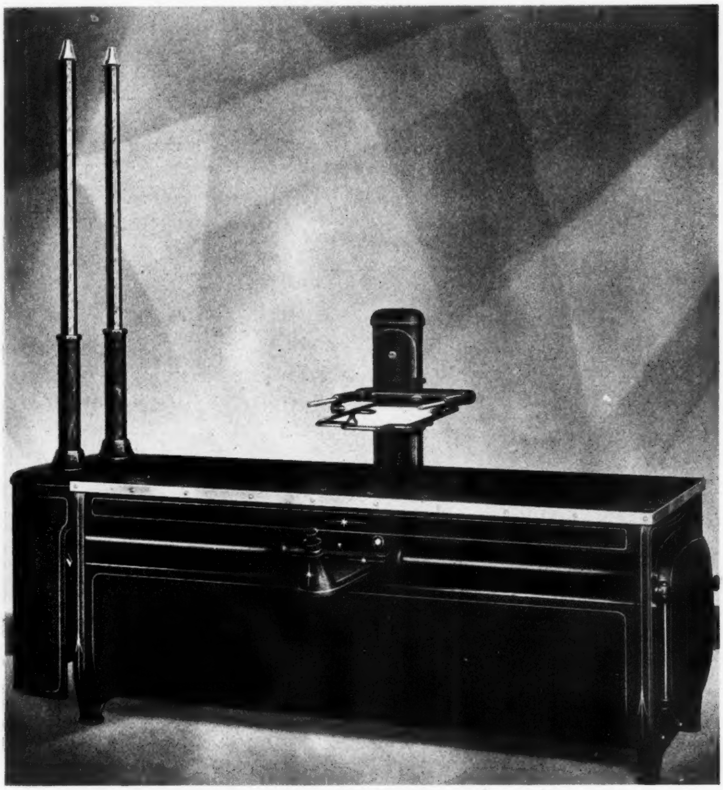


Fig. 6. Like the vertical fluoroscope of the same make, this horizontal fluoroscope has been rendered completely shock-proof by enclosing the tube and conductors in a grounded metal housing. The simplicity of this method of "shock-proofing," and the fact that the usefulness of the apparatus is not in any way interfered with, would seem to corroborate the author's contention that fluoroscopy without complete electrical shielding is no longer justifiable.

PROTECTION OF TECHNICIAN AND RADIOLOGIST

1. Since the scattered rays from the patient, etc., are cut down by filtration, cones, or diaphragms, and proper tube enclosure,

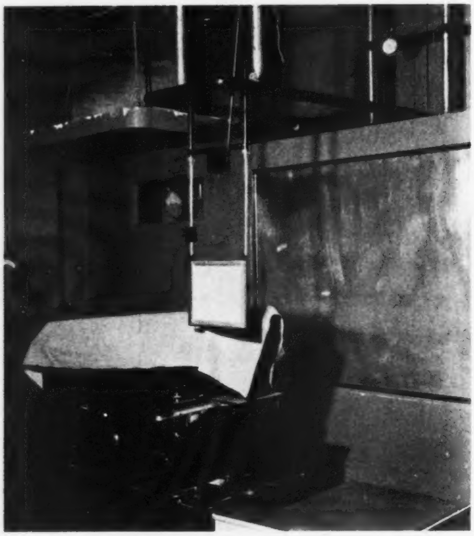


Fig. 7. This home-made shock-proof bi-plane fluoroscope was built by the author and his Research Engineer, Mr. O. C. Hollstein, for the Chevalier Jackson Bronchoscopic Clinic. The tube for the horizontal ray is behind a partition. The ray comes through the aluminum panel. The target-screen distance is 4 feet. The tube and screen move together, being mounted on the same framework. In a later model which we recently built for another hospital, the oil-immersed vertical-ray unit was replaced by a Metalix tube mounted beneath the floor. We believe that in many instances the future will see X-ray tubes mounted beneath floors, behind walls, and above ceilings.

much that is done to cut down exposure to the patient is of great value toward protecting the operator.

2. Large rooms are safer than small ones. If the radiographic room is small, the operator's booth must be the more carefully designed and protected.

3. Detailed specifications of thickness, quality and location of lead glass, metallic lead, etc., are not given here, because these are fully covered in Handbook No. 15 of the United States Bureau of Standards, and in the report of the Advisory X-ray and Radium Protection Committee, published in RADIOLOGY.

HIGH TENSION

The complete safety of everyone, patient, technician, and radiologist, from the possibility of high tension shock, is attainable, though fraught with difficulty. Various methods which have been used successfully are:

1. Immersion of the X-ray tube in the same oil tank with the high tension transformer.

2. Placing the tube in a grounded metallic drum or other enclosure, with insulated and ground-shielded conductors (Figs. 1, 2, 3, 4, 5, and 6).

3. Placing the X-ray tube and transformer behind a partition in an ample enclosure, or in a separate room, with an aluminum or bakelite panel to allow the X-rays to enter the radiographic room. This arrangement is perfectly feasible with all forms of teleroentgenography and telefluoroscopy, and we believe that the roentgen laboratory of to-morrow will make frequent use of this arrangement. Most apparatus for roentgenography of the thorax is so arranged that it would be a relatively simple matter to place the patient and film in a separate room from the X-ray tube.

We have had personal experience with biplane fluoroscopy at a target-screen distance of 4 feet, with the horizontal ray tube behind a partition, and with the vertical ray tube beneath the floor (Fig. 7).

4. Relative, though not absolute, safety is attained by a suitable increase of the target-film distance, when roentgenographing with the tube above the table. For example, a great deal of radiography in the writer's department is done on a 4-foot-radius Potter-Bucky diaphragm table, using 53 inches from the focal spot to the film. With this arrangement, the high tension is so high above the table and floor that it is all but impossible for the patient, or anyone else, to reach it (Fig. 8).

PRESENT STATUS IN PRACTICE

That the American manufacturers of X-ray apparatus are keenly awake to their op-

portunities and responsibilities along these lines must be apparent to anyone who inspects the Technical Exhibit at this meeting. There seems no limit to the degree of safety attainable, once we make up our minds it is desirable. We believe that this development of protection against electric shock will not stop until all high tension is safely shut in. Protection against biologic effects will never reach this level, but it is already accomplished to the necessary degree in every modern roentgen laboratory, and is rapidly improving elsewhere.

SUMMARY

This paper is a brief résumé of the theory and practice of protection (as applied to di-

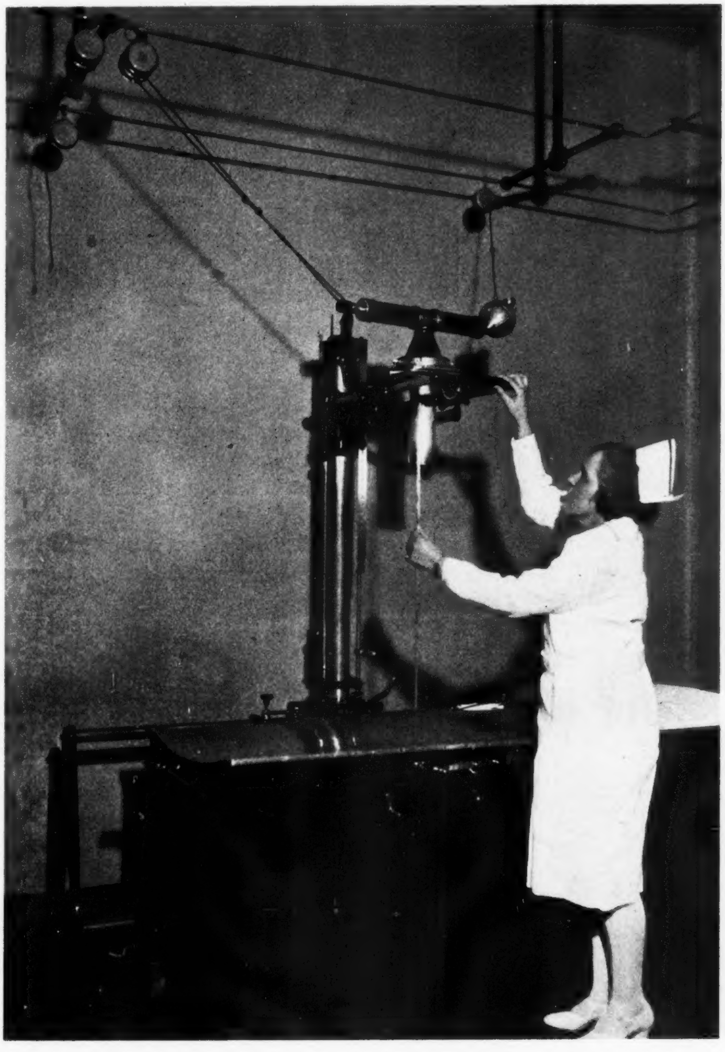


Fig. 8. This specially built table contains a curved type Potter-Bucky diaphragm with 48-inch radius of curvature. With tube at top of tube-stand travel, the target-film distance is 53 inches. This minimizes distortion and increases detail. Owing to the great distance of all the conductors above the floor, this installation is practically, though not theoretically, "shock-proof."

agnostic roentgenology) of patient, technician, and radiologist, against *(A)* biologic effects of X-rays, and *(B)* possibility of electric shock. The necessity for protection is stressed, and methods of accomplishment are described, with selected illustrations. Recent developments have made it possible to obtain ample protection against biologic effects of X-rays, and complete protection against all electrical hazards.

Biology Influencing Social Science Developments.—Increasing knowledge of biological facts and a growing understanding of the underlying principles that bind them together are changing the outlook of the social sciences and "humanities" from anthropocentric, or man-centered, to biocentric, or life-centered. More and more we are thinking of man as a living being vitally connected with the whole web of living organisms, rather than as a separate and special creature set apart from the rest of the world. The old Latin boast, "I am a man, and I count nothing human as foreign to me," must be revised to: "I am alive, and I count nothing living as foreign to me."

This is the central idea of an address on "Hopes in the Biological Sciences" presented before the meeting of the American Philosophical Society by Prof. William Morton Wheeler, Dean of the Bussey Institute for Research in Applied Biology, Harvard University.

Some parts of the biologist's program are already on the road to fulfillment, Prof. Wheeler stated, but others encounter difficulties.

"The biologist sees all departments of chemical and physical engineering receiving an ever-increasing, enthusiastic welcome from the public and a more moderate appreciation of those applications of the biological sciences which are concerned with forestry, agronomy, and medicine. . . . The hopes of eugenics are even less promising than were the hopes of evolution during the last decades of the nineteenth century, because evolution was mainly concerned with a re-orientation of human thinking, whereas eugenics, as applied genetics, demands action. Of the eventual success of at least a part of its program, however, there would seem to be every prospect."—*Science Service.*

LEGAL AND INSURANCE ASPECTS OF PROTECTION IN RADIOLOGY[1]

By H. F. WANVIG, New York

IT is an accepted fact that the use of the roentgen ray in the practice of medicine embodies hazards peculiar to the specialty, in some respects, more severe than those in other departments of the science. Therefore, any approach to the subject of malpractice claims and insurance should first consider some of the hazards that cause claims and make malpractice insurance necessary.

The hazards fall roughly in two general classes, physical and legal.

The physical hazards include faults, or dangers, in the installation or manner of operating roentgen machines and all other items that have to do with contact with the patient before, during, or immediately following roentgen exposure. It does not seem probable that I can say anything about the hazards of installation or technic that would be more than mere routine to roentgenologists, but there are a few items in this general category which are, I think, worthy of special mention.

Attorneys defending malpractice actions constantly complain of the lack of accurate records upon which to construct convincing defenses. In a malpractice defense, all possible information is required. The defendant must be able to reconstruct in his own mind exactly what occurred. His legal counsel must have precise information upon which to prepare his case and present his arguments, and witnesses for the defense are entitled to exact records so that they can testify with a clear knowledge of the facts. Such information can be obtained only from accurate and complete records made at the time treatments are given. It is not enough for a doctor to "recollect" what occurred or to rebuild his data by translations from hastily scrawled memoranda that mean little to anyone but himself. To be of greatest value, his notes, which should indicate by their form and make-up that they were prepared at the time of treatment, should be recorded clearly, fully, and accurately. When required, such records can be presented in court as valuable exhibits.

Case records should not only show routine information, covering the setting of the machine, time, distance, volume, intensity of dose administered, protection given to other parts of the body, etc., but should also indicate that the patient was adequately advised, in advance, of the possible result, the necessity of protecting irradiated areas from subsequent infection, and the measures to be employed. If possible, the records should include a written acknowledgment by the patient that he assumed such part of the risk of treatment as is necessarily his. I do not mean releases, which we all know have little or no legal value. Records of this kind have an extraordinary value in court, and the roentgenologist who does not rigidly hold himself and his assistants to the preparation of them is a poor malpractice risk.

Histories of previous therapy are sometimes difficult to obtain. Patients are frequently referred from other departments of a hospital to the roentgen department without a history chart showing what previous roentgen, or medical, treatments have been given. Some patients are forgetful. When discussing their histories, they forget to mention previous exposures for roentgenoscopic examinations or roentgenograms. Others are deliberately untruthful for reasons of their own, usually because they want

[1]Read before the Radiological Society of North America at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

to check up a previous diagnosis and treatment, or to conceal the fact that they are changing doctors. Some want to increase the amount of their treatment, believing that twice as much roentgen therapy will do them twice as much good. We have a record of a man who underwent treatments from three different doctors. After his death, his family sued the third doctor, but, fortunately, information of the other treatments came to light and the case was won by the defendant. Such cases have made roentgenologists despair of always getting proper information. Yet, however difficult it may be, ways must be found for obtaining accurate histories. As roentgenologists, you know how necessary such information is, and I do not mention the fact with the idea of adding, in any wise, to your consciousness of that necessity. On the other hand, we have had ample cause to wonder if those who have tried to get good histories have always been as succcessful as they might have been had they used more care in explaining to their patients the vital importance, to them, of reporting all previous roentgen exposures or the use of contra-indicated drugs.

The employment of technicians has frequently been cited as one of the elements that make roentgen work more hazardous, from a malpractice standpoint, than other branches of medicine. An examination of 166 roentgen-ray cases by the legal counsel of the New York State Society shows that 40 per cent of them grew out of treatments given by technicians. While it is probably true that other departments of medicine rely upon nurses quite as much as roentgenologists do upon technicians, the difference appears to lie in the fact that roentgen apparatus is always a more powerful agent for inflicting injury than the ordinary instruments used by nurses in general medical or surgical cases. This suggests that much might be accomplished by a closer and a greater amount of supervision of the work of technicians.

Under the heading of "Probable Causes," it was found that 42 per cent of the cases were due to over-exposure, caused by errors in technic, setting timing devices, and leaving out filters. Many appear to have been preventable errors. If the profession could devise positive systems of checking filters and setting roentgen machines that would eliminate the careless and preventable mistakes, it would do more toward reducing the malpractice hazards of the specialty than could be accomplished in any other way.

The legal hazards are those that affect the malpractice liability of doctors by statutory law or decisions of the courts. These risks are always present in the practice of medicine in all of its departments. They bear a direct relation to the number of patients treated, the number of treatments, and the care and skill employed, not omitting, of course, the results obtained. Every treatment given imposes upon the doctor a definite obligation, based upon an expressed contract, or one which the law implies. By undertaking treatment, a doctor, in the eyes of the law, represents that he possesses a reasonable degree of skill and learning such as is possessed by the doctors generally in his locality. He is required by law to use that skill and learning, as well as his best judgment and reasonable care, to bring about a good result. Should he fail in any of these requirements and a bad result occur, the law holds him liable.

His undergraduate and interne education are not enough, because the law requires that he keep abreast of the times; that he keep pace with the accepted progress of modern diagnosis and treatment. Having marked the line of his compulsory progress, the law says that he shall not go beyond the accepted methods of modern practice in seeking a cure.

A superior court said: "When the case

is one as to which a system of treatment has been followed for a long time, there should be no departure from it, unless the surgeon who does it is prepared to take the risk of establishing by his success the propriety and safety of his experiment."

And, further, the law holds a doctor to his task and responsibility, once he has accepted a patient. A court in which this question was raised said: "When a physician is employed to attend upon a sick person, his employment continues while the sickness lasts, and the relation of physician and patient continues unless put an end to by the assent of the parties, or revoked by the express dismissal of the physician."

By these decisions, we are, in effect, directed by the courts to take notice that a doctor must keep up with the modern developments of his profession; that he may not go beyond such modern developments as have been generally accepted, except at his own risk, and that, once treatment has been undertaken, he must continue his responsibility to the patient until dismissed. These are narrow limits indeed. I know of no other profession or undertaking in which legal liability is so closely circumscribed.

In malpractice cases, a bad result does not, in itself, indicate that the doctor has been negligent, and, therefore, is liable. Judge Taft, before going to the Supreme Bench, forcibly pointed out that the principle of *"res ipsa loquitur"* should not apply to malpractice cases. However, plaintiffs' lawyers constantly try to induce the courts to apply this rule and, in at least two States, courts have ruled that roentgen burns may be taken as "some evidence" of negligence. In time, other States may follow that lead. Regardless of the present clear prohibition of the rule, it is probably a fact that the mere existence of a burn has a prejudicial effect upon the minds of many jurors, and no effort should be spared to correct that attitude when an opportunity is presented.

While the burden of combating unfavorable legal rules and principles rests with the attorneys for the defense, roentgenologists should miss no opportunity to inform themselves regarding these rules in order to be able to give their attorneys the maximum amount of assistance when it is needed, and to guide them in their own practices.

These physical and legal hazards, and many others with which everyone is familiar, have combined to make malpractice exposure a troublesome question for the medical profession and for the insurance companies who issue policies against them. As early as 1921, the companies began to see that the risk of insuring roentgen therapy required a higher rate than did other departments of medicine, but it was not until 1924 that roentgen therapy was excluded from general policies and a higher rate charged. This action put the whole question squarely before the profession and there it rests. Since 1924, there has been little change in the cost of therapy losses, therefore, the insurance rates established at the time have remained unchanged. If these rates are so high as to worry those who buy insurance, it is only because the cost of furnishing it is so high that it worries the companies that sell it. That these rates are high compared with the rest of the profession is apparent, but whether they are excessive, when compared with the cost to the companies, is quite another question.

Insurance rates merely measure the hazards of the risks covered. The hazards of roentgen practice cannot be attacked and modified, or eliminated, by anyone except the roentgen-ray specialist. He can do much to reduce those hazards and we may be sure that insurance rates will quickly reflect any resulting decrease in losses. No real progress will be made until the profession itself takes the whole subject in hand. Insurance companies will help, but they will not lead. So long as they can collect premi-

ums that adequately pay them for the risks which they assume, they will be content. When adequate rates are no longer available for any particular kind of risk, they will discontinue insuring that risk.

There is a general impression among roentgenologists that use of the roentgen ray by men without proper education or experience is largely responsible for the present so-called high level of rates. However, our records show that only a little over 25 per cent of the X-ray suits filed are against general practitioners or others owning roentgen apparatus who have no special training or experience in its use. Nearly 75 per cent are brought against specialists on account of their own treatments or those given by their technicians or nurses.

SUMMARY

1. Make accurate, clear, and complete records at the time of treatments, taking care to show what information and instructions were given to the patient.
2. Get accurate histories covering all information required, even if you have to press for it. Particularly avoid the perfunctory compiling of histories by unskilled assistants.
3. See that your patients receive and understand proper instructions for the care of irradiated areas, to protect themselves and you. Especially warn them of the dangers of additional exposures on the same, or adjacent areas, until directed by you.
4. Leave as little to your technicians as you can, and supervise that little as closely as you can.
5. If possible, check all settings and filters on every machine for every treatment.

DISCUSSION

R. R. Newell, M.D. (San Francisco): Dr. Taylor remarked about the carelessness in covering the rooms with lead and then driving nails through the lead. Sixteen-pound lead with a nail hole every 10 cm. might be no better than 8-pound lead if the latter had no holes.

As soon as the report of the Committee in regard to protection was published in the journals, I had the report typewritten and photographic copies made of the artificial respiration method and then had it mounted under glass in each of the rooms in which high tension current is exposed.

Dr. Stenstrom remarked about natural irradiation, and Dr. Failla also spoke of the amount of radium in the crust of the earth and figured out an astonishing amount of radium in the walls of the Empire State Building. To be sure, the intensity of that radiation is very small, nevertheless the intensity of radiation is not the whole story because radiation acts in spots, and any radiation at all is capable of producing just as much injury in one spot as more intense radiation. That is to say, when you reduce the intensity of radiation you diminish the number of spots in which it acts on the body, but each spot may be acted upon just as intensely as by very heavy radiation.

Some of the biologists at the University of California carried a culture of fruit flies, I believe it was, over into Twin Peaks Tunnel in San Francisco, where the natural rate of ionization is about twice what it is in the town of Berkeley, and they found an appreciable increase in the rate of mutation in the culture, showing that even small radiation is capable of producing biologic effects.

Dr. Stenstrom's maximum permissible amount of one erythema dose in ten years is in good agreement with American and foreign standards. Some persons have tolerated much more. I recollect one patient whom we treated for Hodgkin's disease from head to foot over a period of five or six months. Dosage totaled about 1,000 r (in the beam) during the six months' time, so that she received double the ten-year quota in half a year. Instead of killing her, it cured her. When she did die, after five years, it was not with aplastic anemia but of recurrent Hodgkin's.

But it is not safe to figure from what one person can stand, or from what ninety-nine persons out of a hundred can stand. We must

go on the basis of what might be dangerous for the exceptional person.

Dr. Stenstrom suggested the fluoroscopic screen test for X-ray radiation. That is a very sensitive test, is it not, Dr. Stenstrom? You also mentioned the Geiger counter. I supposed that the Geiger counter was something which belonged only to the trained physicists.

Dr. Failla remarked in regard to control by the white blood count. One of these patients who, Dr. Chamberlain thought, had suffered a persistent and continuing anemia because of too much X-ray given several years ago, showed at times an increased white blood count. I wonder if it is true that the white blood cells will always be injured first. I wonder if it is possible that some intensity and continuation of X-ray may injure the hemoglobin portion of the system and still leave a normal or increased number of white blood cells.

Dr. Failla showed slides of a great number of very ingenious apparatuses for protection from radium as one carries it about the hospital. The hole in a radium container should be made small. A box with 5 cm. lead walls about a 2 cm. hole weighs 20 Kg., but if the hole is 5 cm., it weighs almost twice as much.

I was much interested in your report for concrete in relation to lead absorption for very hard X-rays. Was I right in understanding that your figures indicated a reduction to 1 per cent by 28 cm. of concrete? [Yes.] If with diminishing wave length the mass absorption coefficients tend to become nearly the same for all substances, then for very short wave lengths would we not be wise to go to concrete, which is much cheaper per pound than lead?

The legal aspects are extremely important and extremely difficult. Raids on the treasury are a growing racket. When a surgeon undertakes a difficult operation, the attending risk to the patient's life is recognized and accepted as necessary in order to achieve a cure. But if you or I undertake to treat a patient who has a difficult tumor, and we have the temerity to hope to get a cure, we go after it "hammer and tongs." If the patient shows a red skin afterwards, he begins to talk about suing us. That is not fair. The remedy is education. If radiologists generally were bold in treating cancer, and precise and careful to avoid accidents, then people would learn, first, that X-ray is potent, and, second, that a reddened skin may be the necessary price of a sufficient treatment.

What Dr. Stenstrom said about under-treatment is one of the most important things that has been brought out here. I truly believe that there are more patients suffering from malignancy who are done harm by under-treatment than by over-treatment. The only chance one has to do a patient the maximum amount of benefit is to give the full treatment. I believe it is a more serious mistake habitually to fail to take full advantage of that only good chance than it is to over-treat a few patients.

In regard to records: they are extremely important. Everything should go down in writing at the time it is done. The courts will not accept mechanical arrangements—only personal evidence. I think it is better to have two persons sign for the presence of a filter than it is to have the filter screwed in. As a matter of fact when you screw the filter in, everyone stops looking to see that it is there, so that if the electrician or the director unscrews it, its absence will not be noted.

As to nurses and technicians, we do turn over a lot of very important jobs to them. If we looked upon our treatment of cancer patients as seriously as the surgeon looks upon his operation on the cancer patient, we would do the whole of it ourselves. It is true that some busy surgeons do turn over to assistants the task of closing up, but how many of us turn over to our assistants the doing of the whole radiation treatment!

It would be ideal if, for every serious case that we have to treat, we could have a consultation with the patient's physician or surgeon in the presence of a member of the family, so that what we have to offer could be brought out exactly—exactly why the surgeon does not undertake surgical treatment, exactly why the physician does not undertake medicinal treatment, and why, then, the treatment is turned over to us; how poor or how good our chance is of clearing up the patient's dis-

ease, and how great our chance is of getting a severe reaction to our treatment. Then write that down in the records at the time so everybody will know it has been talked about before a friend or relative of the patient. We cannot do it before the patient himself because so often we are dealing with hopeless disease, and it is not fair to tell a patient that he cannot get well.

When the radiologist has a patient referred to him for *diagnosis,* he is a consultant of the patient's physician; but the radiologist to whom the patient is referred for *treatment* becomes inevitably the patient's own physician. We ought to face that fact and have the courage to shoulder that total responsibility for being the patient's physician when he comes to us for treatment, because that is the way he will look at us.

DR. A. MUTSCHELLER (New York City): I am glad to have this opportunity to contribute to the subject of protection against X-rays, some results of my own experiences.

Dr. Taylor mentioned that from 1928 on we had safety protection rules in some countries. In this country from 1925 on, I published, successively, several papers and presented the last one before this Society with the recommendations that the safety protection dose be proposed at the then forthcoming International Congress in Stockholm, as the unit upon which safety recommendations are to be based. I did that at the suggestion of Dr. Kaye, of the National Physical Laboratory, in Teddington, England, and Prof. Glocker, of Germany, for both these gentlemen, who drafted the safety rules for England and Germany, respectively, had accepted my tolerance dose in their recommendations. In fact, when I visited them in Europe less than a year ago, both asked me whether or not I had found any change necessary in this safety tolerance dose. The Chairman at that meeting, Dr. E. C. Ernst, expressed by his remarks that that would be done.

What is that tolerance dose which was accepted in both these countries, and used as a basis for their safety rule recommendations, and why is it so important to have such a tolerance dose? This tolerance dose was arrived at by measuring the intensity of the stray radiation in several therapy laboratories in this country, which, for a number of years, has been proven to be entirely safe. That is, the operators and the personnel in attendance had been engaged in the work for several years, and there had been produced no detectable injurious effect during these several years.

The result was, that while also allowing a large safety factor, *i.e.,* for at least 50 per cent, there is present in such a laboratory a radiation intensity which amounts in one month to about one hundredth part of an erythema dose. This dose was subsequently checked with doses found by others, and particularly by Quimby and Viol, Fricke and Jacobson, and lastly by Barclay in England. The latter also had measured the dose which he found one particular technician could tolerate without incurring any visible injurious effects. His dose was considerably larger, but after I had corresponded with him and given him my reasons, he agreed that a reasonable safety factor should be applied, and corrected his manuscript accordingly and agreed that it would not be justifiable to make the permissible dose just as large as possible, and that, applying approximately the same safety factor which we had applied, his dose came very close to being of the same magnitude, *i.e.,* one hundredth part of an erythema dose per month.

In other words, this safety tolerance dose has been re-checked in a good many different ways; it has been accepted by European protection committees and used as a basis for their calculations, and there appear to be no indications that a change is indicated at the present time. A short time ago, however, I had a letter from Prof. Glocker, and a reprint in which he recommends that the protection screen thickness of 5 mm. of lead for 200 K.V. radiation might be decreased to 4.5 millimeters. Even if we agree to this reduction, we find that the American recommendations of 4 mm. for 200 K.V. are quite appreciably below the German recommendations. For that reason I submit that the recommendations given in the U. S. B. S. Handbook No. 15 are for insufficient thicknesses of lead for the following reasons: First, for the reason that

the protection afforded by 4 mm. of lead with 200 K.V. radiation is probably not that of one-hundredth part of an erythema dose per month under ordinary working conditions, and second, for the reason that I believe exposure quantities, or exposure times, should be considered to a greater extent.

We have, of course, to deal always with present-day conditions, and the speed of our photographic material and of our intensifying screens has increased so that the actual exposure times for radiographic work have been reduced to approximately one-half of what they were years ago. On the other hand, it seems that fluoroscopic examinations are gradually becoming longer, and that fluoroscopy is being used more and more, so that the time factor, as time goes on, should be re-considered, and, if necessary, taken into consideration in calculating protective screen thicknesses. So, for instance, the lead thickness for protective screens for diagnostic X-ray work could perhaps be reduced, for the reason that even though exposures are made throughout the entire day, the total exposure time probably sums up to less than it did formerly. On the other hand, it seems that the protection at present surrounding fluoroscopic tubes is to a large extent inadequate for the reason that ordinary fluoroscopic examinations last longer than they used to do, and also that our present lead glass coverings are not affording the required degree of protection under the safety rules.

In reading over the protection recommendations printed in Handbook No. 15, I feel that many points, of course, can be elaborated upon, and illustrations can be given that cover the rules laid down. From my own experience, and from having seen many installations throughout this and European countries, it seems that the questions of aeration and ventilation are usually not treated with the care which those subjects deserve. Not only do the protection or sanitation rules demand emphatically that the operator's booth be as well ventilated and airy as possible, but the same also applies to the patient's room, for one of the effective causes of after-sickness is, of course, the inhalation of vitiated air resulting from X-ray exposures and corona bombardment.

In the same way we find that the question of actual protection is not always viewed from as serious an angle as it should be. For instance, I know of several cases in which serious damage has been done to the hair of technicians because X-rays from the tube fell upon wood structures in the operator's booth, there releasing such large amounts of secondary radiation that several operators lost their hair. Similar injuries were observed in a laboratory in which the floors were not lead lined, and in which, consequently, direct X-rays could be reflected *via* the secondary radiation around the lower edge of the protective wall—serious damage to the feet of one operator resulted. For that reason I have often thought that safety recommendations might be much more detailed, and that every known case of injury should perhaps be kept on record as an example of what may take place if safety recommendations are taken too lightly.

In addition to this I would like to mention the fact that it is so easy to acquire bad habits, such as, for instance, the unknowing exposure of ourselves to X-rays, thereby exceeding the tolerance dose. I believe it has been definitely proven that much can be accomplished if only we will not stand in front of X-ray tubes, or in front of fluoroscopes with the shutters wide open, and so on. For that reason, in addition to the fact that every laboratory director may be anxious to test the sufficiency of his protection, I believe that important question has not been dealt with nor has it been accorded a place of prominence corresponding to its importance—only in one short paragraph on the last page of these recommendations, and I think the text is not described in a manner that makes it really satisfactory.

The recommendations are that a film should be carried by the operator for fifteen working days, and that if, after developing, there is an appreciable darkening, the cause shall be investigated, and eliminated. I can imagine that if a technician is anxious to have a holiday, he can easily stretch a point and fog the film slightly, or over-develop it, or thrust it into

a warm solution, and thus accomplish what he desires.

The use of a fluoroscope, as recommended on the same page, is really an unsatisfactory method, for it depends to a large extent on the intent of the one who makes the investigation. The same holds true with Geiger counters, which are extremely sensitive, and with which one can count almost anything one may desire. Apparently the only method which is easy to carry out, and at the same time has a reasonable degree of accuracy, is that recommended in 1928. According to that, the technician is to carry a film for one week, then a film of the same kind, and from the same package, is to be exposed to a known irradiation, as, for instance, to one-four hundredth of an erythema dose. The two films are then developed together, and, on comparing their intensities, we are able to compare a definite radiation intensity on the film exposed to a known radiation with the intensity on the film carried by the operator. If the film carried by the operator is darker than the one exposed to the known radiation, then it is definite that the tolerance dose has been exceeded. If, however, the film is lighter, or equal in darkness, then it is an assurance that the protection is adequate, and that the technician does not unnecessarily incur the danger of radiation. Therefore, if this method is properly carried out, it tells us two things: Firstly, whether or not the technician is adequately protected, and secondly, whether or not, by omitting to expose himself to the radiation, the degree of his protection cannot otherwise be improved.

Dr. A. U. Desjardins (Rochester, Minn.): The one thing that struck me was the statement made by Dr. Stenstrom about the frequent insufficiency of treatment, or lack of thoroughness of treatment. We see patients referred from all over the country, and I venture to say that from 70 to 75 per cent of those who have had previous treatment have had either insufficient treatment or treatment that has not been thorough.

The next point is about recording not only the number of hours and the physical conditions of treatment, but the scheme of treatment; by this I mean not only the number of fields, but the exact location of the fields, the direction of the beams, and everything. This requires an anatomic diagram and careful charting; there is no other way. I find it absolutely necessary and invaluable later in reviewing cases, to get a mental picture of just how the treatment was given; otherwise, I cannot be sure how it was applied. From many years of experience I know that the relation of the different beams to one another and to the patient makes a great deal of difference in the effect of treatment.

One more point is that not every clinical disturbance or change in a technician or radiologist is due to radiation. I do not want to minimize the possibility of danger, for we must be careful and the more careful the better; frequently clinicians, surgeons, and many radiologists regard any clinical disturbance as due to radiation, when there may be no relation between the two. Some four years ago I happened to meet one of my old technicians, who had been away from radiation work for a year and a half. Before this she had been with us for only one year, and before that had had two years of non-radiological work. She had worked about two years with radium. She told me that she had just been examined and her blood count had been found very low. She was told that this was due to radiation. When I asked her about the symptoms, she told me they were chiefly about the head. I then asked, "How about your sinuses? Have you had those examined?" "No." Whereupon, I advised her to have these examined. Infected sinuses were found and after the infection was dealt with, her difficulties disappeared. Her blood count returned to normal in three months.

K. W. Stenstrom, Ph.D. (Minneapolis, Minn.): I might say that those figures on adequate protection given by different men seem to show fairly good agreement. Dr. Newell considered 0.1 roentgen per day as safe and I referred to one erythema in ten years. If we consider one erythema equal to 600 roentgens then my statement would correspond to 60 roentgens per year, or 5 r per month, or about 0.2 per day.

Dr. Newell: I give 0.1 r per day.

Dr. Stenstrom: Dr. Mutscheller found by means of measurement that the radiation in the operators' room amounted to about 0.01 erythema per month in some places. We found experimentally that at our place the dose was somewhat smaller.

Regarding the point that Dr. Mutscheller made that the thickness of lead ought to be increased to 5 mm. when 200 K.V. is used, I agree that the thickness ought to be more than the 4 mm. recommended in the "rules." That means that the sum of the thickness of the lead in the wall and in the tube protection ought to be more than 4 millimeters. It is, however, not enough to make this statement. It is necessary to have the wall covered with lead even if no direct radiation strikes it; but in this case 4 mm. of lead in the wall should be more than necessary, as the scattered radiation is softer than the direct radiation.

J. L. Weatherwax, M.A. (Philadelphia, Pa.): Practically everything pertaining to protection has been covered, so I will not go into that at all. But there is one thing that I would like to discuss, and that is with reference to X-ray technicians carrying on treatments.

Throughout almost all the hospitals in Philadelphia, we have organized our technicians and taught them in such a way that they can carry on treatments routinely under the guidance of the radiologist. I work with a great many of these hospitals, and I am sure that the work done by technicians, in setting up the patients and giving treatment, is of as high a quality as the roentgenologist would give himself. The technician has one job to do, and that is to set the patient up according to the way that he or she has been taught to do it.

We have had technicians under the guidance of a radiologist routinely treating patients in our institution for a number of years, and we have never had any trouble whatsoever as far as an X-ray reaction is concerned. We get reactions, and I believe, as Dr. Stenstrom has said, that we must show some degree of reaction if we hope to give the patient sufficient radiation to obtain the desired results. We tell our patients that they will get a skin reaction, and in the ten years that we have been doing radiation therapy at the Philadelphia General Hospital, we have never had any legal trouble and there is no indication of legal trouble.

Dr. I. S. Trostler (Chicago, Ill.): From the medico-legal standpoint, I think that one of the most important things that we as radiotherapists should stress, as was brought out by Dr. Newell in his discussion, is to tell a member of the patient's family that we expect to get a skin reaction. Then when we do get that skin reaction they will not immediately rush to the office of a lawyer and start a malpractice suit.

Our records should show that we have made this statement to a relative of the patient, in the presence of a witness. We do not have to inform the patient; but with the exception of cases of malignancy we may as well make that statement in the presence of the patient.

I have talked with over a hundred radiologists in regard to this matter, and have found that when they have made the assertion to the attorney for the plaintiff—in case of such malpractice suit—that they had made such a statement before a witness, to the patient or a member of his family, and *have a record of having done so*, the attorney has withdrawn from the case, if such attorney was honest and ethical.

Dr. W. L. Ross (Omaha, Nebraska): I want to say a word about the prevention of reactions from the skin where we are using X-ray from day to day. Clinically, I have been using the X-ray for about fifteen years or more. At first it was quite common to get a redness and itching of the skin, and at that time a great many different remedies were suggested, such as the application of some sort of alkali.

Almost all of them have been discarded, but I have found two things to stand me in hand to prevent the itching that is first noted, and next the redness of the skin. I invariably tell my patients to apply salted butter over the area exposed and to leave it on for half an hour following each treatment and to continue it for a week after the treatments are discontinued. In addition to that, I apply a very

soft high frequency current through a vacuum electrode. For the last four or five years I have rarely had any erythema. I invariably treat the patient right after the X-ray exposure with the soft high frequency current, which I generally use from five to ten minutes. It must be very soft. You can get much softer rays out of the vacuum electrode than you can get out of the non-vacuum electrode, and, understand all the time, that it is not an effect on the deeper tissues that you are trying to get out of the high frequency. It is just to protect the thin film of skin that has been over-stimulated.

DR. W. S. LAWRENCE (Memphis, Tenn.): I do not think the previous statement should go without question and without word of caution. It has been pretty well demonstrated that everything done for an actual or potential X-ray burn is very nearly in the nature of adding insult to injury. Some years ago a great many men advocated treating with ultra-violet to prevent an X-ray burn; and still it has been demonstrated experimentally over and over again that ultra-violet increases the X-ray effect and that hot applications make matters worse. Anything that over-stimulates or damages the skin in the least would make the X-ray effect more manifest, and not less. Likely if the gentleman has been getting apparent effects from what he speaks of as soft rays from a high frequency vacuum electrode (which in my understanding of the matter are not rays at all), he has been deceiving himself. The reason he got the apparent preventing effect was that he had not given enough X-ray in the beginning to produce anything like an erythema.

One other thing, referring to Dr. Trostler's remarks: There is a tremendous leeway between an X-ray erythema, mild or even pronounced, and an X-ray burn, or destructive erythema. I do not believe that suits are ever developed from simply a marked or pronounced erythema. The conditions that bring on suits are those in which the skin slips off and leaves an X-ray slough. The perfectly wise and sensible thing to do, which I think most of us have done, and will do, or are doing, is to tell the patient or the patient's family of the possibility or probability of some skin reaction resembling sunburn—with which they are all familiar and of which they are not at all afraid.

DR. W. L. ROSS (Omaha, Neb.): May I correct a misapprehension of what I said? I spoke in favor of absolutely doing something before your erythema developed. I was not giving any treatment after erythema or mild or severe dermatitis had developed. That was not the object at all. It was to prevent any erythema from showing up, and it is a very mild form of treatment that I advocated. So do not misunderstand me. I did not advocate ultra-violet at all. It was high frequency.

DR. NEWELL: What do you consider your maximum safe dose, Doctor? From what doses are you rescuing the patients from dermatitis by using butter?

DR. ROSS: I advocate the use of butter simply because it contains salt and is soothing to the skin surface.

A far as the maximum dose of X-ray is concerned in producing or preventing erythema, it varies so with different individuals and different skins that, as you know, what will produce an erythema with one will not with another. Irrespective of the X-ray dosage, I make it a practice to use salted butter and high frequency in all cases of daily exposure to X-ray.

DR. J. S. YOUNG (St. Louis, Mo.): The first thing that I would like to ask is, if there is absolutely no effect or counter-effect of ultra-violet, why is it that we do get results in treatment of X-ray dermatitis from ultra-violet?

I have now three cases in which I am sure that we have gotten some very good results from the treatment, or apparently so, from ultra-violet. I am always open to conviction. If you can show me where we have no results, I would like to know your reasons for it. I will cite one particular case in which we had on one hand a second-degree dermatitis on the fourth finger, a third-degree dermatitis on the second finger, and probably a first-degree dermatitis on the first finger. The second- and first-degree dermatites have healed

completely. The third-degree dermatitis has reduced in size about two-thirds, and we attribute that to the ultra-violet treatment. I would like to hear some explanation of that.

Dr. A. U. Desjardins (Rochester, Minn.): May I make some explanations in partial answer to this question? MacKee and Andrews, Pfahler, and others have shown experimentally that ultra-violet radiation in addition to X-radiation simply adds to the effect. Therefore, if there has been marked erythema this will be increased by exposure to ultra-violet rays. This has been conclusively established, and there can be no doubt about it.

I think Sampson was responsible for the legend that exposure of an X-ray dermatitis to a strong dose of ultra-violet rays would cure the dermatitis. Such teaching is the rankest heresy and wholly at variance with the facts. In cases of third-degree radiodermatitis, the ulcer may fail to heal and the patient may have severe pain for weeks, months, and sometimes for several years. In almost every instance the pain and the failure of epithelium to grow over are due to secondary infection. The important thing is to combat the secondary infection; as soon as this subsides, the pain also disappears. Some patients who have taken narcotics for months find this unnecessary. In some of these cases, after the secondary infection has been brought under control, short exposures to ultra-violet rays often hasten healing of the ulcer. When available, I prefer sunlight in small doses; large doses of ultra-violet rays should never be used.

As to the use of butter, I might say that it is well known in dermatology that any oily or greasy substance, any ointment, will give relief simply by removing contact of these irradiated surfaces from the air. So if butter or anything else will give relief under those conditions, it is perfectly all right.

But it has also been shown by MacKee and other dermatologists that greasy ointments in general have a tendency to increase the erythema rather than diminish it. So you have to be a little careful, and why butter should do the opposite, I do not know. I would, therefore, be a little skeptical about it.

Dr. W. S. Lawrence (Memphis, Tenn.): I realize that the question asked by the gentleman who spoke of the burns on the three fingers of the first, second, and third degree has not been adequately answered, and I want to try to do that. He asks what did it if that did not do it. He gave the patient small doses of ultra-violet, the patient got well, and that was proof-positive. Remember that it is just one case that he cites, yet that was proof-positive that the ultra-violet did it.

I think it was "Dr." Abraham Lincoln who first said, "Time is a wonderful healer." Time is what did the work, time and keeping it clean. In my judgment you were deceiving yourself; and the gentleman who gave the infinitesimal doses of high frequency has likewise been deceiving himself. But I do not think that it is out of the question to do something in these cases—chiefly for the patient's mental benefit. One of the best things to do is to give oxide of zinc ointment to whiten the reddened area, or, better than that, paint the whole region with mercurochrome. That won't do a particle of harm and the patient then can't tell whether an erythema has developed or not.

Dr. G. Failla (closing): So many different points have been brought up to-day and so much interest has been shown in this subject, that the discussion might be continued indefinitely. The lateness of the hour, however, makes it necessary to end the discussion. I shall take only a few minutes to answer a few of the questions which have been raised.

Dr. Newell inquired about the sensitivity of the fluorescent screen. I believe that under proper conditions, that is, in complete darkness and with the eye fully accommodated, the fluorescent screen can be used to detect very small intensities of X-rays. It should be noted, however, that there is an important distinction between the use of a fluorescent screen and a photographic plate or film for the detection of X-rays. The former reacts to a certain *intensity* of X-rays, whereas the latter records a certain *quantity* of radiation. This quantity may be attained by exposing the film to a very

low intensity for a long time. Accordingly, in the ultimate analysis, the film is capable of detecting extremely small intensities of X-rays.

As to the possibility of an effect being produced on the red blood corpuscles before a depression of the white count is noticeable, I can only say that in the case of the many technicians we have examined at the Memorial Hospital, this has not been the case. The white count has always been affected first, but the red count is also influenced by prolonged exposure to radiation.

In regard to the relative merits of lead and concrete as absorbers of X-rays, I may point out that lead is a more efficient absorber even in the case of gamma rays. That is, a lead wall of the same *weight* as a concrete wall absorbs considerably more gamma radiation than the latter. Furthermore, the lead wall, of course, is much thinner. It is perfectly feasible to use either material to attain the same degree of protection. Where space is not important concrete might be preferable. In our case we have used lead for the protective enclosure of the 900 K.V. machine for three reasons: (1) the space available was very limited; (2) more certain protection is afforded by lead because it cannot crack, and (3) the lead can be used again in case the machine is moved to other quarters.

In conclusion, I wish to take this opportunity to thank those who prepared papers for this symposium. The time and thought which they spent on this work, I am sure, will be appreciated by the members of this Society and all radiologists.

Research Shows Diet Not Responsible for Cancer.—Diet is not responsible for the development of cancer, it appears from experiments reported by Sir Leonard Hill in the *Lancet.* Sir Leonard described his studies of mice on different diets and different beddings, which he conducted in the National Institute for Medical Research.

"Cancers have occurred indifferently in mice on all diets and on all beddings," he reported. "The significant influence has been age."

While some of the diets had an effect on the size of the mice and their reproductive ability, there was no effect on the development of cancers.

Two-fifths of the cancers occurred spontaneously, the mice dying between the ages of one and one-half and two years. About one-third of the cancers occurred in mice dying between two and two and one-half years. Three years in a mouse corresponds to very old age in a man, Sir Leonard Hill pointed out.

Besides reporting his investigations of mice, Sir Leonard Hill recounted observations on the relation of cancer and diet made by other investigators. In this connection he quoted a report of the Imperial Cancer Research Laboratory, as follows: "There is no reliable evidence, experimental, statistical, or clinical, which would indicate a causal correlation between cancer and the absence, or the presence, or the excess of any particular dietetic constituent. Sensational statements to the contrary are unfounded and ill-considered, and serve only to alarm the public."

HODGKIN'S DISEASE[1]

By E. L. JENKINSON, M.D., CHICAGO

THE etiology, symptoms, prognosis, and pathology of Hodgkin's disease have been thoroughly covered by many writers, particularly Yates and Raine, Bunting, and others. I am chiefly concerned with the accompanying osseous changes and the treatment. I am quite sure that the incidence of bone involvement in Hodgkin's disease is much higher than the literature would lead us to believe. As we become more thorough in our examinations, insisting upon complete radiologic investigation of the skeleton, more and more will we find osseous involvement.

At the present writing, it is impossible to give statistics on the frequency with which bony changes occur. One cannot rely on the figures quoted in the older literature—the autopsies were not complete, and thorough X-ray examinations were not made.

It has occurred to us in the study of our cases that there is a similarity between bone metastases following carcinoma and bone changes in Hodgkin's disease. Review of the bones usually attacked by carcinomas and Hodgkin's disease shows them to be parallel. As is true in carcinoma, so in Hodgkin's disease also, the vertebræ, ribs, pelvis, and femora most frequently show changes.

These findings lead us to believe that the disease invades areas rich in red marrow. The cases we have examined revealed no changes in the bones distal to the elbows or knees. We know that there is an absence of red marrow in these bones after puberty. We are also aware that metastasis from carcinoma is relatively infrequent in these same bones. These observations have furnished material for speculation, so that we ask the question, "Are the diseases similar in their methods of bone invasion?"

It is true, as far as we know, that Hodgkin's disease starts in the lymphatics, for a long period remaining confined to them. To admit these facts tends to discourage any further theorizing. However, we were not content to drop the subject and, on further investigation, found cases diagnosed as carcinoma of the lymph glands of the cervical region, proven by biopsy, with definite areas of metastasis in the ilium. It seems unlikely that the disease spread to the ilium by way of the lymphatics. It seems more reasonable and more probable that the extension was hematogenous. We are bearing in mind Handley's[2] work in which he presents the theory that cancer is disseminated by permeation of the lymphatics. Handley believed that metastasis occurred by extension of the tumor cells through the deep fascial lymphatics. It seems reasonable to assume that carcinoma of the breast might easily spread to the adjacent structures by way of the lymphatics, but the possibility of carcinoma of the breast metastasizing to the proximal third of the femur, by way of the lymphatics, does not seem reasonable or likely. The hematogenous route seems more accessible and plausible.

Von Recklinghausen[3] holds that tumors spread through the blood stream into the bone marrow. The large number of distant bone metastases would lead one to believe there is sufficient proof to substantiate his belief.

To take a neutral position, one must admit that tumors may spread by both avenues,

[1]Read before the Radiological Society of North America at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

[2]HANDLEY, W. S.: Cancer of the Breast and Its Operative Treatment, John Murray, London, 1906, pp. 1-176.

[3]VON RECKLINGHAUSEN, F. D.: Die Fibrose oder deformiderende Ostitis die Osteomalacie und die osteoplastiche Carcinose in ihren—gegenseitizen Bezie hungen. Festschr. der Assisteuten für Virchow, 1891, p. 17.

but, undoubtedly, most spread through the blood. Considering these facts as they apply to bone metastasis in carcinoma, we feel that metastasis to the bones in Hodgkin's disease is similar.

As in carcinoma, the bone changes are of two types, namely, osteoblastic and osteoclastic. The osteoblastic type shows considerable new bone formation, the bones being rather dense and homogeneous. The osteoclastic type, as in carcinoma, shows bone destruction and is by far more common than the osteoblastic.

Patients showing osteoblastic changes are usually in better physical condition, and, we believe, live longer. This is quite parallel with carcinoma metastases.

There is one other point which tends to make one think that the two diseases at least are similar in their methods of bone metastasis. Bone involvement is usually a rather late finding in both diseases, and the finding of osseous changes generally means that the patient is in the terminal period.

I have never observed bone changes in early Hodgkin's disease. I do not mean to infer they do not occur, as we, like others, have not carefully examined the skeleton in all of our cases. They may be found, after further study and more prompt radiologic examination, to be a common early finding, although, with our present information, we must consider bone changes as a late development in Hodgkin's disease.

On reviewing our films, we have been unable to find anything characteristic which might lead one to the diagnosis of Hodgkin's disease independent of the history, clinical findings, and sections. The disease causes both destructive and proliferative changes, but many other diseases do likewise. A differential diagnosis from the X-ray findings alone is impossible.

Another roentgenographic observation is the resistance which cartilage seems to offer to the progress of the disease. I have no recollection of the disease ever having attacked a joint or passed through a joint. (This is also quite typical of metastatic carcinoma.) Infections have no respect for joints and cartilage. It is common to see them destroy a joint surface, passing through to the opposite articular surface.

TREATMENT OF HODGKIN'S DISEASE

For a number of years, we treated the entire lymphatic system of all patients suffering from Hodgkin's disease. This was considered as a prophylactic precaution. We were under the impression that, by treating the body from the hips to the head, the chance of the disease becoming generalized was minimized.

This practice was carried on for a long period, and we certainly did observe a marked improvement in the adenopathies. Disappearance of the enlarged glands is not unusual: glands far removed from the area irradiated usually become perceptibly smaller. Many explanations and theories have been offered for this phenomenon, such as secondary rays, and the possibility that the constituents of the blood may become radioactive. Some three years ago, we discontinued the practice of generalized irradiation in Hodgkin's disease and began treating only the enlarged glands. We then placed the patient on a liberal diet, accompanied by plenty of rest and sunshine. The belief was that improving the patient's resistance acted as a definite barrier to the progress of the disease.

When a patient presents himself for treatment and we find enlarged cervical and axillary glands, we irradiate these areas, using a dose up to the point of a mild erythema. We attempt to destroy the glands with one treatment. We then send the patient home, giving no more treatment unless other glands become enlarged.

This method was advocated by Dr. J. L.

Yates, for whom we have treated many patients. As we were familiar with Dr. Yates' work on diseases of the lymphatics and his work with Dr. Bunting, we were quite willing to try his method. Since our adoption of this procedure, our results have been better. Patients have lived longer and required less treatment.

One very important observation made since we have used our present method, is the absence of destruction of the blood-forming apparatus. With the older method, we have seen many patients in whom no glands could be palpated, but who were very weak and emaciated. The blood count usually showed a low hemoglobin content, with low red and an alarmingly low white count. When these patients are put on blood-building diets and transfusions, there is practically no response. The blood-forming apparatus has been destroyed, probably by the extensive irradiation.

We have experienced one serious mishap following irradiation of the entire trunk for Hodgkin's disease. We have never felt that the ill effects attributed by the pathologist to X-rays were due to the irradiation. In this case, the patient died as a result of a large perforated gastric ulcer. The pathologist, discussing the autopsy findings, very dogmatically stated that the cause of this large ulcer was the roentgen therapy.

The patient had not been treated for three months prior to his death. In December, he had received 300 r over the posterior and 300 r over the anterior abdomen, using 0.5 Cu plus 1 Al. The following February, he came into the hospital, complaining of pain in the abdomen which did not respond to medical treatment. The patient became progressively worse and surgery was advised. At operation, free pus was found in the peritoneal cavity. Drains were inserted and the abdomen closed. The following day the patient died. At autopsy a large ulcer, about 6 inches in diameter, with a perforated area about 0.5 inch in diameter, was found on the posterior wall of the stomach.

If the ulcer was due to only moderate doses of irradiation, it seems peculiar that we rarely see these ulcers in the treatment of cancer in patients who receive large doses. The opinions of many radiologists and pathologists were solicited, and all were agreed that the ulcer was independent of the irradiation.

In October, 1928, a patient was referred to us for X-ray treatment who had been treated for three years for Hodgkin's disease, proven by biopsy. On examination the patient was found to be very weak; he walked with the aid of a cane, only with great difficulty. For the month preceding examination he had been confined to bed.

Physical examination revealed no palpable glands, but the left thigh was greatly swollen and there was much edema of the left ankle. X-ray films showed a destructive process, involving the proximal third of the left femur. There were areas of destruction interspersed with thick, dense trabeculæ. The thigh was very painful, even when it was immobilized. The examination of the chest showed no evidence of bone involvement; the lungs and mediastinum were unusually clear.

The blood count was: red, 2,220,000; white 3,250; hemoglobin, 38; lymphocytes, 21; monocytes, 2; polymorphonuclears, 60; eosinophils, 15; band, 2. Anisocytosis—Type 4.

Previous to admission under our care, the patient had had frequent X-ray treatments to the glands of the neck and groins. When the bone lesion was discovered, he received irradiation over this area, using moderate voltage. For a short period during the treatment of the femur, there seemed to be definite evidence of regeneration of the bone. However, the pain recurred, and destruction displaced the repaired bone.

During this period of time, he received with apparent benefit, six blood transfu-

sions. In May he decided to change physicians and was given extensive X-ray therapy to enlarged abdominal glands, receiving much benefit and remaining quite well until August, 1929, when pain and weakness again developed. At this time the patient was very anemic and the blood count alarmingly low. Four blood transfusions were given. At the time of admittance to our care, the blood count was so low that we decided not to give further irradiation until the general condition was improved. He was put on iron-liver extract, and given blood transfusions from a robust man of about 35 years of age, using whole blood. Finally, after four transfusions and diet his count, Dec. 15, 1930, was: red, 3,580,000; white, 4,600; hemoglobin, 62 per cent.

Following consultation with Dr. Yates, it was decided to give deep X-ray therapy to the femur, using small doses frequently along with weekly blood transfusions.

Following roentgen therapy, the pain in the femur subsided and the patient remained quite comfortable during his stay in the hospital. The blood count, however, could not be kept up and each transfusion seemed to be of less value. His blood-forming apparatus seemed to be destroyed. On Dec. 20, 1930, we sent him to Florida, thinking the sunshine and warm weather might help his general condition.

His stay there was not beneficial, the pain becoming worse. The thigh became very large and hard. The ankle and flank became edematous. On Feb. 13, 1931, he returned to Chicago very weak, and it was evident he was nearing the end. His blood count was: red, 2,520,000; white, 2,650; hemoglobin, 46 per cent.

During his stay in the hospital, he developed diplopia and very severe headaches. Nodules were seen in the scalp and small destructive areas were found in the skull. The edema became very marked and diuretics, such as salyrgen, were given with no marked benefit. The edema and woody consistency of the thigh, we believe, were due to the irradiation. The tissues were hard and leathery, and a mass could be palpated.

The patient's relatives desired to take him home, and, inasmuch as nothing more could be done at the hospital, we consented. On April 12, 1931, he died.

POSTMORTEM FINDINGS

The histologic picture of the tumor tissue in the sections of the mesentery was that of a Hodgkin's granuloma, with the typical confusion of many cell forms commonly seen in this disease.

The cell forms included large and small lymphocytes, plasma cells, eosinophile cells, endothelial cells, and endothelial giant cells. The endothelial cells, which were larger than lymphocytes, were pale, with elongated, rather pale, vesicular nuclei. The numerous giant cells varied considerably in size and contained from one to five or six large vesicular nuclei. These were rounded, indented, or multilobed, usually lying close together. In the nuclei of the giant cells there was one, sometimes two, rather deeply staining nucleolus. The cytoplasm was clear but scanty. The giant cells generally resembled the Dorothy Reed type. There were all gradations, from the mononuclear endothelial cell to the multinuclear endothelial giant cell. The endothelial cells, including the giant cells, formed the bulk of the tumor cells. The lymphocytes were not numerous. Some of the tumor cells were atypical; many of them contained hyperchromatic nuclei or bizarre mitotic figures. In this respect the tumor cells were more malignant in appearance than is usual in Hodgkin's granuloma; it is probable, therefore, that this was Hodgkin's sarcoma. The growth was not characteristic of lymphosarcoma. The reticulum was not very evident in some sections, whereas only hyalinized fibrous tissue, containing but a few small areas of tumor cells, was found in other sections.

In the femur, islands of bone were noted in areas composed of cellular tumor tissue. The bone marrow was entirely replaced by dense hyalinized connective tissue, containing only a few small areas of tumor cells. Sections of the mass about the femur in the thigh revealed tumor invasion of the connective tissue between the muscle bundles.

In sections of the liver, there were apparently a few tumor cells among the red blood corpuscles in the lumen of a larger blood vessel; otherwise no tumor tissue was evident here. There was slight atrophy, brown pigmentation, and fat-infiltration of the parenchymatous cells about the central veins (slight passive hyperemia). There were a few endothelial leukocytes laden with yellow-brown pigment in the sinusoids near the central veins. Only a few round cells were observed in the connective tissue of the portal spaces.

In the kidneys, there were small areas of tumor cells infiltrating the connective tissue stroma between the tubules. Although surrounded the glomeruli were not invaded. Hyaline casts and pink granular material were found in a few of the tubules; occasionally a tubule was dilated. The glomeruli were generally large, their epithelial cells somewhat vacuolated as if from lipoid degeneration. Some of the tubules and glomeruli did not stain, whether from necrosis or postmortem change it was difficult to say. An occasional glomerulus was hyalinized.

At first glance, the spleen seemed free from tumor tissue, but more careful examination disclosed the presence of a few scattered endothelial cells, containing from two to four vesicular nuclei such as those seen in the mesentery. The lymph follicles were small. There were numerous droplets of yellow-brown pigment, probably hemosiderin, in endothelial leukocytes and in the reticulum. The capsule and trabeculæ were thickened with increased fibrous tissue.

Summary.—This was a case of malignant lymphoma (Hodgkin's type) in which apparently complete disappearance of the original involvement in the neck occurred. At necropsy there was found: a mesenteric mass; infiltration in the kidney, and involvement of the bone marrow and periosteum of the femur. The latter is an uncommon, but not unknown, feature of this disease.

We feel that this patient was greatly benefited by X-ray therapy. He was more improved under doses directed to the involved glands than under generalized therapy. Following the generalized irradiation, the patient became very anemic, from which he did not recover. His blood-forming apparatus, which was destroyed, had no power of recuperation. I am aware that the disease might well cause the destruction, but, up to the time of the general irradiation, his blood remained quite normal. It is our opinion that isolated treatments directed to the involved glands does not tend to deplete the blood as much as extensive treatments.

A patient with bone involvement, whom we saw and treated in December, 1930, shows the benefit which can be obtained from well directed X-ray treatments.

The patient, a male, age 28 years, came to the hospital for X-ray therapy for Hodgkin's disease, so proven at the Mayo Clinic in December, 1928. At the time of admission to the hospital, Dec. 1, 1930, the patient was complaining of severe pain in his left leg, with edema of the ankle. He was well nourished but had lost 38 pounds since the onset of symptoms. During his stay in the hospital, he ran an afternoon temperature which was usually around 102°.

The urine showed nothing of importance. Blood count: red, 3,360,000; white, 11,000; hemoglobin, 61. Differential count, 300 cells. Lymphocytes, 33; monocytes, 7; polymorphonuclears, 23; eosinophils, 3; basophils, 2; band-shaped, 9; metamyelocytes, 2; myelocytes, 1. Type III. The blood chemistry was within normal limits; the blood calcium, 12.18.

The radiologic examination of the chest

showed the lung fields to be clear, except for an old empyema, seen in the right base. The mediastinum was clearly outlined, showing nothing of importance. The pelvis exhibited definite bone changes; the bones were very dense, probably due to the fact that the patient had taken cod liver oil and calcium.

There were definite changes in the left ischium, showing sclerosis and destruction. It was considerably widened, the sclerosis extending upward into the left acetabulum. Close examination revealed new bone formation laid down parallel to the ischium.

The patient was given X-ray treatments using 1 Cu + 1 Al, with 200 K.V.P., directed to the ischium. Posteriorly, 560 r in air were given, and 630 r anteriorly. The patient was sent home and placed on Blaud's Pills, viosterol, and liver extract, which he took religiously.

His pain was relieved and the swelling of his ankle subsided. The patient gained and by April, 1931, he weighed more than he ever had before. His temperature also returned to normal.

The blood count on April 16, 1931, was: red, 4,610,000; white, 6,950; hemoglobin, 95 per cent. Polymorphonuclears, 62; small lymphocytes, 10; large lymphocytes, 24; transitionals, 3; eosinophils, 1.

Upon recurrence of the pain in the pelvis, since the blood count and general condition were very satisfactory, we decided to give another series to the lower pelvis, using the same factors. The result was prompt benefit to the patient.

The blood count was:

May 19, 1931.—Red, 4,860,000; white, 11,000; hemoglobin, 95 per cent. Polymorphonuclears, 89; small lymphocytes, 3; large lymphocytes, 5; eosinophils, 3.

July 13, 1931.—Red, 4,500,000; white, 6,900; hemoglobin, 98 per cent. Polymorphonuclears, 69; large lymphocytes, 17; small lymphocytes, 12; eosinophils, 2.

July 29, 1931.—Red, 5,030,000; white, 7,250; hemoglobin, 97 per cent. Polymorphonuclears, 67; small lymphocytes, 21; large lymphocytes, 8; transitionals, 4.

During the latter part of August, further X-ray examinations of the pelvis showed a marked improvement in the bony structure. The areas of absorption were much ameliorated, and the bones quite homogeneous.

Because the patient complained of pain on walking, on Sept. 9, 10, and 11, 1931, we gave him three treatments, two over the posterior pelvis and one over the anterior right pelvis, using 560 r posteriorly and 280 r anteriorly.

The blood count on October 6, 1931, was: red, 5,080,000; white, 5,900; hemoglobin, 98 per cent. Polymorphonuclears, 52; small lymphocytes, 33; large lymphocytes, 12; basophils, 2.

The last time we saw this patient he was feeling very well and the pain on walking was greatly reduced.

The important consideration in this case, other than the response to irradiation, was the improvement in the blood count despite rather heavy therapy. We feel that localized treatment certainly causes less destruction of the blood than generalized irradiation. The use of blood-building foods and drugs, such as iron, liver, peaches, prunes, and apricots, is of value in building up the blood. Viosterol, cod liver oil, and calcium chloride certainly stimulate bone production, even in diseased bones.

SUMMARY

1. Bone changes in Hodgkin's disease are not uncommon.

2. Our observations have led us to believe that the extension of Hodgkin's disease to the bones is similar to the extension from carcinoma.

3. The vertebræ, ribs, bones of the pelvis, and the proximal third of the femora are usually involved.

4. Bones rich in red bone marrow are attacked, whereas bones poor in red marrow are relatively free of involvement.

5. The X-ray findings are not sufficiently characteristic to make a diagnosis of the disease in the absence of clinical findings.

6. Cartilage, from our experience, is resistant to Hodgkin's disease.

7. We feel that localized, well directed irradiation is superior to generalized treatment.

DISCUSSION

Dr. A. U. Desjardins (Rochester, Minn.): The whole group of lymphoblastomas contains so many different phases that, in the short time allowed, I could not begin to touch on many. The first point that interests me is the bone lesions. It is perfectly true that, in a certain small proportion of cases in the late stages of the disease, invasion of bone does occur, apparently as a part of the disease.

On the other hand, there is a still larger group in which lesions may result from pressure by enlarged lymph nodes. I have seen this in the sternum, from pressure of mediastinal nodes, in the ilium, from enlarged iliac nodes, and in the vertebræ, from enlarged retroperitoneal nodes. Therefore, both possibilities must be considered. Many seem to think that it takes a great deal of pressure to erode a bone. It does not. It is only necessary that the pressure be sufficient to interfere with the circulation of the periosteum; and, if such pressure lasts long enough, erosion, even of adult bone, will occur. In children, erosion develops even more rapidly.

Another question is that which relates to general irradiation and local irradiation. The choice, I think, must depend on the circumstances under which each radiologist works.

If the patients come from a limited radius, so that they can be seen and treated at frequent intervals without undue financial and physical stress, then local irradiation is perfectly proper and wise. If, on the other hand, one is working with patients coming from Kansas, from Texas, from California, from New York State, from the upper peninsula of Michigan, etc., the problem is quite different. Many patients are poor and cannot come back frequently. If adequate facilities for treatment are not available for hundreds of miles, it is essential to give patients a form of treatment which will keep them in the best possible condition for as long a period of time as is possible.

Until 1924, we followed the scheme of local irradiation. We treated only those regions in which there was definite and visible involvement, but we often found that patients had hardly had time to return home before lymphadenopathy would appear in some other region.

The result was that, in 1924, we began to modify our scheme of treatment by irradiating, at one time, the areas obviously involved and also the mediastinal and retro-abdominal nodes, at first, usually through the back only. We gave one, two, and sometimes three, such courses of treatment at intervals of three or four weeks. Subsequently, treatment was limited to the regions in which fresh adenopathy developed. Thus, we have been able to keep patients in better condition for a longer time than we had been able to before.

In my experience, fever in lymphoblastoma generally means abdominal involvement. My reason for this deduction is that, when a patient has fever, judicious irradiation of the abdomen is usually followed by diminution, or disappearance, of fever as the lymphadenopathy recedes. This occurs so frequently that, when a patient with fever is referred to us, we almost take for granted retroperitoneal or omental lymphadenopathy, and we are seldom proved wrong.

Dr. Aaron Arkin (Chicago, Ill.): In the last two and one-half years, on our service at the County Hospital, we have adopted the plan of making X-ray studies of the bones in most cases of Hodgkin's disease, especially if there is pain or swelling. In this period, I have seen eight cases with extensive bone involvement.

One was very interesting. A young man, 24 years old, was admitted to the hospital with a large lumbar mass and paralysis of both lower extremities. Examination revealed a charac-

teristic relapsing fever with periods of a temperature of from 100° to 102° for from five to ten days, followed by several days of normal temperature. There was generalized lymph gland enlargement. Biopsy of one of the lymph nodes showed a very active form of lymphogranuloma. A good orthopedic surgeon made the diagnosis of Pott's disease, but my explanation was lymphogranulomatosis of the lumbar spine with an external pachymeningitis. The X-ray studies revealed extensive osteoclastic and osteoplastic changes in the first and second lumbar vertebræ, the destruction involving the transverse processes of the second lumbar vertebra, which is rarely seen in tuberculosis. A laminectomy was done, revealing lymphogranuloma of the vertebra with a large lymphogranulomatous mass compressing the dura against the spinal cord. This agreed with our diagnosis, as we had seen the same condition, postmortem, in three other cases. The laminectomy relieved the pressure symptoms and the boy regained the use of his lower extremities. However, he died a few months later of generalized Hodgkin's disease.

I have also seen a case with extensive involvement of the pelvic bones. Another case of the abdominal type, with tremendous enlargement of the liver and spleen, later developed intercostal pain. Films of the dorsal spine revealed extensive destruction of the ninth dorsal vertebra. X-ray treatment caused the liver to return to normal size, in spite of the fact that there was complicating perihepatitis with a friction rub.

In a woman, 35 years old, with slight general adenopathy, we found extensive destruction of the right clavicle, which, histologically, revealed Hodgkin's disease. Another patient presented extensive destruction of the right humerus, with marked induration of the surrounding soft tissues and swelling. I have also seen lesions in the ribs, and in the radius. In fact, any part of the osseous system may be affected.

I do not think that we are justified, from our pathologic studies or clinical observations, in calling this disease lymphoblastoma. This term confuses even more the present status of this disease. A blastoma is a neoplasm, and we are not justified in considering Hodgkin's disease as such.

At present the evidence is in favor of the infectious theory. As in tuberculosis, syphilis, and actinomycosis, so in lymphogranuloma, any tissue or organ may be involved by hematogenous or lymphatic spread. The extensive involvement does not justify the use of the term blastoma. The relapsing fever, the course of the disease, and the microscopic findings speak rather for an infectious granuloma. I have seen Hodgkin's disease with extensive lung involvement which suggested a primary pulmonary infection similar to tuberculosis. The lung areas may be very large and simulate several other diseases.

I should like to suggest an addition to Dr. Jenkinson's two types of bone change, as follows:

1. Osteoclastic
2. Osteoplastic
3. Combined
4. Indifferent

Unless microscopic examinations are made of the various bony structures, the last of these types is overlooked. In this type, the bone marrow is replaced by lymphogranuloma without sufficient bone change to produce X-ray findings. Only the pathologist who makes microscopic sections can exclude the presence of metastases in the bones or other tissues. The spleen and liver are involved in a very high percentage of cases seen postmortem.

Dr. Desjardins: I agree with Dr. Arkin that the preponderance of evidence at the present time tends to support the idea that at least Hodgkin's disease, and probably most of these lymphoid disturbances, have a chronic infectious basis. I do not mean that they are infectious in character, but that the etiologic background is probably one of chronic infection.

Nevertheless, by the time we see the patients, there is no question but that we are dealing with a malignant disease. It kills nearly all of them, metastasizing to various organs. If that is not malignant, I do not know what is.

In the case referred to by Dr. Arkin, the friction rub and various other points indicate

actual liver enlargement. True enlargement of the liver unquestionably occurs, but in many cases the impression of enlargement appears to be due to the organ being pushed forward and downward by enlarged retroperitoneal nodes. When the lymphoid hyperplasia is made to recede by irradiation, the liver as promptly resumes its normal position and size. I have seen this so many times that I cannot draw any other conclusion.

Dr. Arkin: Liver metastases are demonstrated by the pathologist in a very high percentage of cases. Some of the largest livers I have seen have been in Hodgkin's disease, these showing extensive areas of necrosis, yellow in color.

The liver is very frequently involved in Hodgkin's disease.

Dr. Desjardins: In what percentage does your pathologist show involvement of the liver? Our records show it in less than 20 per cent of the cases.

Dr. Arkin: I should say in the spleen about 40 and in the liver about 20 per cent.

Dr. Desjardins: That is not so very high.

Dr. Jenkinson (closing): I do not doubt what Dr. Desjardins has said about fever, but a great many of these cases present fever very early. It is one of the earliest symptoms we find. At the present time, we have under observation a man whom we have been treating for, I think, about seven years. All he has ever had, as far as we can determine, are a few pathologic cervical and axillary glands, but fever has been one of his main symptoms. He comes back occasionally and we treat the involved glands.

I think, as Dr. Desjardins says, that generalized irradiation depends upon the patient, and, after all, he is the first one to be considered. We did, for a long time, give generalized irradiation and a number of our cases improved—at least their adenopathies subsided, becoming smaller. There are men treating Hodgkin's disease who have the patients return again and again, for the duration of their lives, which is absolutely wrong. These radiologists are not going to help their patients; they are going to kill them. That is why I think that practice is bad.

MEDICAL EXPERT WITNESS RECEIVING A PERCENTAGE OF AMOUNT OF JUDGMENT FOR HIS FEE

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., Chicago

ASIDE from and in addition to the reasons that it is against public policy and extremely bad ethical practice on the part of all who are in any way connected with such a transaction, the principle of a witness arranging that the amount of his fee be dependent upon the amount or value of the verdict tends to induce perjury in favor of the contestants of the case using such witness. As such, it must be condemned and disapproved.

There are several leading Supreme Court decisions to the effect and meaning that a contract to pay a witness for testifying, coupled with the condition that the amount of his compensation depends on the outcome or result of the suit in which his testimony is used, is contrary to public policy and void, because it tends to perjury and the perversion of justice. Among these may be cited: Clifford *vs.* Hughes, 139 App. Div. 730, 124 N. Y. Supp. 478.

State *vs.* First Bank of Nickerson, 184 Neb. 423, 207 N. W. R. 674, etc.

Miller *vs.* Anderson, 183 Wis. 163, 196 N. W. R., 869, 34 A. L. R. 1529.

County of Campbell *vs.* Howard, 113 Va. 19, 112 S. E. R. 876.

In the following case (Davis *vs.* Smoot (N. C.), 97 S. E. R. 488), a physician witness who arranged for and made it a point to immediately collect 20 per cent of the amount of the verdict, was compelled to repay the $125 so collected and was rightfully threatened with contempt of court proceedings. This should be a good object lesson to any witness who may be contemplating making or being tempted to make such an arrangement or contract.

The Supreme Court of North Carolina, in 1919, affirmed a judgment in favor of the plaintiff, administrator of the estate of one A. M. Davis, against the defendant, a physician, for $125, the amount which the defendant had collected from A. M. Davis for testifying as a witness in a personal injury case against the city, in which Davis recovered $625.

The Court said: "These issues were submitted to the jury in this action against the physician: (1) Did the defendant knowingly, designedly, wilfully, and maliciously and unlawfully charge A. M. Davis 20 per cent of the amount recovered by A. M. Davis from the city as alleged in the complaint? *Answer:* Yes. (2) What amount, if anything, is the defendant indebted to the plaintiff? *Answer:* $125."

. . . .

"The defense was rested on the ground that the agreement was void as against public policy, and hence that the money having been paid, the plaintiff administrator could not recover it back. It is public policy that such a transaction as this cannot be allowed to stand simply because the defendant was able to enforce payment of the illegal exaction.

"Besides, there was in this case evidence that the defendant physician gave said A. M. Davis morphine and other medicines, that the latter's mind while the defendant was visiting him and giving him morphine was in a very unsatisfactory condition, and that the defendant, who 'had made a very good witness,' collected the $125 with great promptness after A. M. Davis had received it.

"The ground of the recovery sought by the plaintiff administrator was, not that the defendant swore falsely in favor of A. M. Davis, but that he made representations that his testimony would be more effective if he were paid 20 per cent of the amount that

A. M. Davis recovered, and that after the trial he collected said 20 per cent out of the client over and above his expert witness fee of $10 allowed by the court.

"This court will not only not enforce a contract of this kind, but will compel repayment when collection has been made and there is evidence that the party making payment was under treatment and also under the influence of morphine administered by the defendant until after the money was paid him, and that thereafter when his physician was changed the patient's mind improved, and he made an effort to secure the return of the money.

"On the verdict on the first issue, that the money had been 'designedly, wilfully, maliciously and unlawfully collected by the defendant,' the court very promptly gave judgment for its return. No court with a proper sense of its own dignity and of purity in the administration of justice, which should always be above suspicion, could permit such a transaction to stand, simply because the offender has been quick enough to secure payment before proper action could be taken.

"The defendant on the verdict was guilty of gross contempt of court. It is commended to the consideration of the court below, whether, on the evidence in this case, proceedings in contempt should not be brought by the court in vindication of public justice, and it is for the solicitor to consider whether a bill should not be laid before the grand jury for indictment of perjury in view of the intimation by the defense in this trial that A. M. Davis was unduly benefited by the too favorable testimony of the defendant in the trial of the action against the city. The transaction is not one that the court can in justice allow to go off without investigation.

"The answer did not deny the receipt of the 20 per cent by the defendant, but alleged that it was a voluntary gift. But the defendant did not go on the stand nor put on any evidence to support such defense. This certainly calls for investigation by the court. Such conduct by a witness as was here described and indicated by the verdict, strikes at the very heart and root of the administration of justice. The courts cannot be too careful and scrupulous in this particular."

CASES CITED[1]

WORKMEN'S COMPENSATION COMMISSIONER HAS POWER TO PUNISH FOR CONTEMPT

In re Hayes (N. C.), 156 S.E.R. 791

On March 3, 1930, Dr. R. B. Hayes was present as a witness before the chairman of the North Carolina Industrial Commission. He had professionally attended the claimant, who was seeking compensation. Dr. Hayes had been sworn and had testified on both direct and cross-examination. The chairman of the Commission then asked Dr. Hayes whether he had an opinion as to whether or not a blow received by the claimant on October 19 would have produced a paralytic stroke on January 12. Dr. Hayes admitted that he had an opinion, but he refused to express it unless he received compensation as an expert. Section 3893 of the Consolidated Statutes provides that experts, when compelled to attend and testify as witnesses, shall be allowed such compensation and mileage as the court in its discretion may allow. The chairman of the Commission, however, maintained that it was not up to him to qualify Dr. Hayes as an expert and committed him to jail for contempt of what the chairman described as "the Court." Dr. Hayes sought to obtain his release through a writ of *habeas corpus*, but failed. Thereupon he obtained a writ of *certiorari* for a review of the case by the Supreme Court of North Carolina.

Power is expressly conferred by the statute creating the North Carolina Industrial

[1]Reprinted by permission from the *Journal of the American Medical Association.*

Commission, said the Supreme Court, for that Commission or any member of it to subpena witnesses to attend and testify at a hearing before the full Commission or before any member, and the statute provides that "the Superior Court shall, on application of the Commission or any member or deputy thereof, enforce by proper proceedings the attendance and testimony of witnesses and the production and examination of books, papers, and records." This provision that the Legislature had made for enforcement by the Superior Court of the attendance and testimony of witnesses and the production and examination of books, papers, and records, however, the Supreme Court thought was not adequate for a situation such as that presented in the present case. If a witness in attendance at a hearing, after having been duly sworn, can with impunity refuse to answer a question propounded to him which is pertinent to the matters in dispute between the parties, then, the Supreme Court thought, the Industrial Commission would be without adequate power to perform its duties. Since the Legislature in providing the Commission with the aid of the Superior Court in enforcing the attendance and testimony of witnesses did not in express terms—nor, in the opinion of the Supreme Court, by implication—deny to the Commission or any member thereof the power to compel a witness in attendance at a hearing, after having been duly sworn, to testify, the court, without deciding whether the North Carolina Industrial Commission was or was not a court, and without citing any statutory authority or judicial precedent in support of its opinion, concluded that the Commission or any of its members has the power to adjudge a witness in contempt who has deliberately and persistently refused to answer a question propounded to him and to punish such witness by fine or imprisonment. The judgment of the Industrial Commissioner was therefore affirmed.

The question raised by Dr. Hayes at the hearing before the chairman of the Industrial Commission, said the Supreme Court, when he refused to answer the question addressed to him because it was addressed to him as an expert and he had not been paid as an expert nor assured that he would be so paid, was not presented to the Supreme Court for decision and had not been decided by that court. It has been held in a few courts that a witness who has been summoned as an expert in a judicial investigation cannot be adjudged in contempt for refusing to give such testimony unless he has been compensated for his professional opinion. The better opinion, however, said the Supreme Court of North Carolina, is that an expert summoned to testify, who refuses to answer questions "without compensation other than his witness fees," is in contempt, and when an expert voluntarily submits himself to an examination as such, he can in no case refuse to answer one particular question after having without objection answered others.

ADMISSIBILITY OF PHYSICIAN'S OFFICE RECORDS

Ohme *vs.* Bisimanis (Ala.), 132 So.R. 161

The appellee, Dennis Bisimanis, based his suit on double hernias, which he claimed were caused by his having been negligently struck by the defendants, with an automobile, Oct. 30, 1929. The case was tried, Jan. 30, 1930, and judgment given in favor of Bisimanis. Thereafter the defendants learned that some time before the date of the alleged accident a physician had found that Bisimanis was then suffering from double hernias. They then moved for a new trial, on the ground of newly discovered evidence. In connection with that motion, it was stipulated between counsel for Bisimanis and counsel for the defendants that a certain physician, if he were present

and testifying on the motion, would testify that the records in his office showed that he examined one Dennis Bisimanis in his office, March 25, 1929, and found that he was suffering from double hernia, and that he advised an operation, but that the physician had no recollection of the matter independent of his office records. A rehearing was denied, and the defendants appealed to the Supreme Court of Alabama. On behalf of Bisimanis it was argued that neither the hospital [*sic*] records nor their contents were evidence of the facts. But, said the Supreme Court, these records, under the well settled rules of the court, were admissible on proof that the witness knew the facts when the records were made, knows that the records show the true facts, and now has no independent recollection. The cause was remanded for a new trial.

CATCHING OF NERVE IN FRACTURE: EVIDENCE: FAILING TO USE ROENTGEN RAY

Ingwersen *vs.* Carr & Brannon *et al.* (Ia.), 164 N.W.R. 217

The Supreme Court of Iowa, in reversing a judgment obtained by the plaintiff and remanding this cause for a new trial, says that the petition alleged that the plaintiff sustained a fracture of his left arm, the humerus being broken at the juncture of the upper and middle thirds, and the broken ends of the bone being so separated and not in apposition that the musculospiral nerve was drawn in between the pieces of bone. There was evidence that, to show the plaintiff's daughter where the break was, the defendant then in attendance, who had given the plaintiff an anesthetic, raised the arm on a level with the shoulder, then straightened out the arm, and applied splints and a bandage. The plaintiff's theory was that the oblique fracture of the humerus involved the musculospiral groove, containing the nerve, and that when the defendant manipulated the arm, and bent it at the point where it was broken, the nerve slipped in and was caught when the two pieces of bone closed up, and that it was negligence to fail to find out that the nerve was caught before the splints and bandage were applied, which should have been done by the getting of crepitus. For the defendants there was evidence which tended to show that crepitus was obtained, the fracture reduced, temporary splints applied, the forearm and hand placed in a sling, and the arm encased in a muslin swathe extending around the body. The defendants contended that the plaintiff had two injuries—the fractured humerus and an injury to the nerves; that they treated the fractured humerus and treated the nerve expectantly; that is, waited to give Nature a chance to clear up the paralysis without surgical interference, relying on Nature to clear up the injury to the nerve. The discovery of the musculospiral nerve between the broken ends of the bone was made by another surgeon, who cut down on the fracture something like eight weeks after that was sustained, and the defendants contended that the fact that the nerve was between the broken fragments of the bone then did not tend to prove that it was there two months before, when the arm was first dressed by the defendants; that presumptions do not relate backward. But the Court thinks there were circumstances which tended to show, and from which the jury could have found, that the nerve was caught prior to or at the time of the defendant's first visit. There was a conflict in the testimony which made this a jury question.

The jury was instructed that it was not to take for granted that the statements contained in the hypothetic questions were true, but that it should scrutinize the evidence and determine what, if any, averments were true, and that if it should find that some of the material statements were not correct and were of such a character as entirely to

destroy the reliability of opinions based on the hypothesis stated, it might attach no weight whatever to the opinions based thereon; that an opinion based on a hypothesis wholly incorrectly assumed, or incorrect in its material facts, and to such an extent as to impair the value of the opinion, is of little or no value. It was contended that the jury should not be permitted to determine the materiality of assumed facts incorporated in hypothetic questions; that the materiality of such facts is a question to be determined by the Court, and the Supreme Court holds that it was for the error in this instruction that the case must be reversed.

It was also error not to permit the defendant who performed the most of the services in the treatment of the plaintiff to be asked as to whether the best of his professional ability was brought to bear on the case; whether or not he exercised his best skill and knowledge in the treatment of the case, and what was the fact about his having exercised the utmost good faith as well as his best skill and ability in the treatment of this case. These questions were not leading or suggestive, nor did they call for the conclusion of the witness.

There was no error in admitting evidence as to there being roentgen-ray machines in the town in which the defendants were practising that were available to them. That they did not use a roentgen-ray machine was a circumstance to be considered by the jury as bearing on the question as to whether they failed to use ordinary care to discover that the nerve was caught.

REMOVING SUPERFLUOUS HAIR WITH ELECTRIC NEEDLE IS PRACTISING MEDICINE

Engel *vs.* Gerstenfeld (N. Y.) 168 N. Y. Supp. 434

The Supreme Court of New York, Appellate Term, Second Department, reverses a judgment obtained by the plaintiff for a balance claimed to be due for the removal with the electric needle of superfluous hair from the face of the defendant's niece, a Miss Abrams, because the plaintiff, not being a licensed and registered physician, in undertaking to treat Miss Abrams for the growth of hair on her face, violated the provision of the public health law regulating the practice of medicine. Justice Benedict holds that, as the plaintiff committed a misdemeanor in undertaking to treat the "deformity" or "physical condition" of the skin of Miss Abrams, the plaintiff was not entitled to recover in this action. Justice Clark concurs in the result, on the ground that the plaintiff practised medicine, in that, following the definition of the statute, she held herself out as being able to diagnose, treat, and operate for a certain physical condition, and undertook to diagnose, treat, and operate for such physical condition. Justice Callaghan dissents.

Justice Benedict says the "practice of medicine" is defined in the statute as follows:

"A person practises medicine within the meaning of this article, except as hereinafter stated, who holds himself out as being able to diagnose, treat, operate, or prescribe for any human disease, pain, injury, deformity, or physical condition, and who shall either offer or undertake, by any means or method, to diagnose, treat, operate, or prescribe for any human disease, pain, injury, deformity, or physical condition."

The growth of hair on Miss Abrams' face when she went to the plaintiff was a "deformity" or a "physical condition," of which she, or the defendant, desired the aid of the plaintiff in the treatment and cure; and the plaintiff clearly held herself out to them as being able to treat it successfully, and did undertake to treat it with an instrument known as an electric needle. The statute plainly means that a person holds himself out as being able and willing to diagnose or treat any human disease or "de-

formity" or "physical condition" when he represents or states to a patient that he possesses the skill or ability requisite for the case. It is not essential that the "holding out" should be by way of public announcement. If there be a "holding out" of oneself as willing to undertake the treatment and able to administer it, then it follows that this constitutes the practice of medicine within the terms of the statute. Nor can it be said that the removal of hair from the face of a woman by the use of an electric needle does not properly come within the category of the practice of medicine any more than the removal of hair from the face of a man by the use of a razor would. Bouvier's Law Dictionary, speaking of surgery, says, "The practice of surgery is limited to manual operations usually performed by surgical instruments or appliances." The use of an electric needle would obviously come within this definition.

The definition of the term "practice of medicine" contained in the statute may be thought by some persons to be highly artificial. It includes, and was designed to include, many things not popularly considered as medical practice. But the wisdom of the law, if it be constitutional, is a matter for the consideration of the Legislature and not of the courts. It may well be argued that four years of medical study, including a thorough knowledge of anatomy, materia medica, hygiene, etc., in all their branches, are not requisite to equip a person properly to remove superfluous hair alone. Yet it can hardly be contended that persons engaging in that occupation should not be subject to some sort of regulation to insure proper skill and sanitation, such at least as the regulations affecting the practice of chiropody. The Legislature has seen fit to set a much higher standard, and until the statute herein discussed is amended or abrogated, the courts have no discretion but to enforce it.

CASE REPORTS AND NEW DEVICES

A PROPOSED DIAPHRAGM FOR STANDARD IONIZATION CHAMBERS[1]

By HERMAN E. SEEMANN, Ph.D.
From the Kodak Research Laboratories, Rochester, N. Y.

It is a well-known fact that the results of measurements made with a standard ionization chamber cannot be known with a greater degree of accuracy than the cross-sectional area of the limiting diaphragm. If a diaphragm were constructed with straight sides instead of the conventional round hole, the straight sides could probably be more easily and accurately fine-ground than the round hole. The following design for a diaphragm is proposed with the idea that probably somewhat greater accuracy may be obtained by its use and simple construction be retained. The diaphragm described is only *apparently* more complicated than a circular hole cut in a solid plate.

Two lead-bismuth alloy[2] plates A and A' (Fig. 1) are fastened together at their ends with simple metal yokes. Their edges E and E' are accurately machined for straightness and are as nearly parallel as possible. If a second pair of plates is similarly arranged and laid over the first pair at right-angles to it, the device in Figure 1 *(B)* re-

[1]We are indebted to Mr. M. V. Bacon, of our laboratory shop, for certain practical suggestions regarding construction.

[2]Taylor advises against the use of "hard" lead in favor of "hard" gold or lead-calcium alloy. Radiology, January, 1932, XVIII, 113.

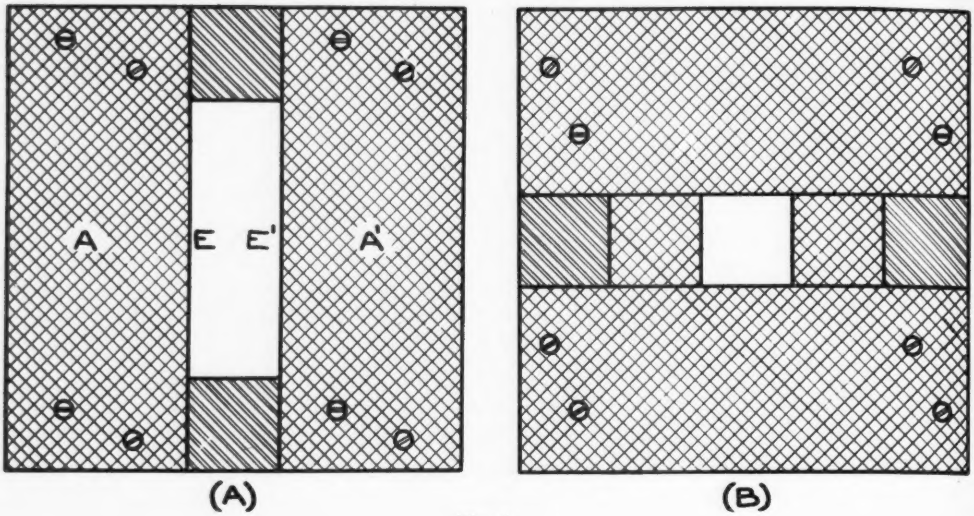


Fig. 1.

sults. The two pairs of plates thus mounted together comprise an easily constructed diaphragm.

The size of the opening is most accurately determined by measuring the distance between the plates of each pair at equal intervals along their entire length. Perhaps a slight taper (lack of parallelism) of the edges will be detected, but with reasonably good machine work on the edges the *uniformity of the taper* should be very good. The mean of these measurements is then the effective width of the diaphragm. It is to be noted that, when measurements are made near the ends of the plates, a more accurate determination of the effective width of the diaphragm is obtained than with measurements on the diaphragm only, assuming accurately straight edges. Great accuracy in crossing the plates at right-angles is not essential since, for example, the area of the parallelogram formed by the crossing of such plates at 89 degrees is only about 0.015 per cent greater than if crossed at 90 degrees.

Owing to the necessity for thick plates to absorb the X-rays, a correction must be made for the fact that the two pairs of plates are at different distances from the source. No more data than are normally taken or known in standardization work are necessary to make this correction. Referring to the schematic diagram (Fig. 2), we see that slit *"A"* is defining the beam in the vertical direction at distance X_1, and *"B"* is defining it in the horizontal direction at X_2. It is assumed that the distance X_1 is the most convenient to measure directly.

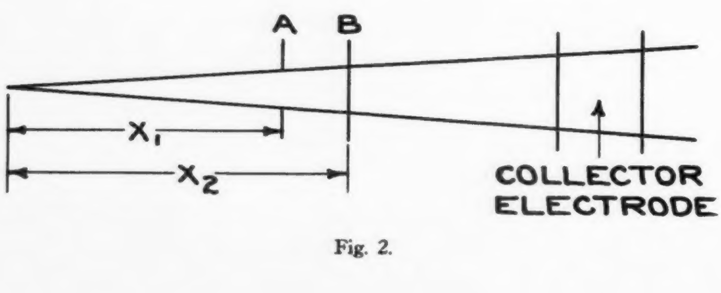


Fig. 2.

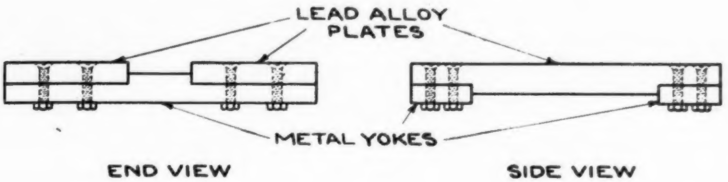


Fig. 3.

The effective width of "*B*," that is, the width it would need to have at X_1 in order to limit the beam to the same extent, is $\frac{X_1}{X_2}b$, where "b" is the measured width of "*B*." Thus, the effective area of the diaphragm at distance X_1 is $\frac{X_1}{X_2}ab$.

If desired, this type of diaphragm could be made adjustable by equipping the pairs of plates with micrometer screws.

The utility of the crossed slit diaphragm does not depend upon the shape of the edge chosen.

Figure 3 illustrates a method of insuring rigidity.

AN UNUSUAL FOREIGN BODY IN THE STOMACH[1]

By ARTHUR LEDERER, M.D., Pathologist and Roentgenologist, Veterans' Administration Hospital, JEFFERSON BARRACKS, MISSOURI

In studying the X-ray films of the abdominal area of a 93-year-old Civil War veteran, who was a patient in Veterans' Administration Hospital, Jefferson Barracks, Mo., an unusual foreign body was observed on the left side of the lumbar spine and somewhat above the iliac crest. The author does not recall having seen any such a foreign body on any other X-ray film, nor did a cursory search of the literature furnish any precedent. Inquiry among some widely experienced civilian roentgenologists added no information.

Figure 1 furnishes a better conception of this foreign body than can be obtained by mere description. The first point to be settled was whether or not this shadow originated from extraneous sources and, if not, if the shadow was fixed in the position first seen. A large number of films, made at intervals extending over several weeks, proved that the body was definitely fixed, but that it moved upward with the patient in the prone position. Having established this fact, it now remained to identify the exact location of the foreign body, its nature, and its relation to the clinical history. Since the foreign body has the shape of a coil, it shall be so referred to in this discussion.

Fig. 1. (Retouched film.)

The first impression one receives in viewing the film is of a large calcified nematode, but the circular ends of the tape-like body, and its width, suggest that it is a tube, flexible and radiopaque. The odd shape weighs against its being a calcified blood vessel.

The patient was admitted to the hospital July 21, 1931. He comes from a family in

[1]Published with permission of the Medical Director of the United States Veterans' Bureau, who assumes no responsibility for the opinions expressed or the conclusions drawn by the writer.

which the father reached the age of 110 years and the mother lived to be 100 years old. The patient, who is of medium height and stocky build, has had no diseases of childhood. During his service in the Civil War, he was wounded in the right leg, but there was no injury to the chest or abdomen. No laparotomy scars were visible, and there were no markings of any sort on the skin. He had also served in the Spanish-American War but did not remember the exact dates of service. His hearing was greatly impaired and his memory somewhat faulty. He did not, however, present evidence of senile mental deterioration to a point at which one would have had to doubt the veracity of his statements. The patient came to the hospital suffering from shortness of breath and some cardiac pain; he could not rest while lying down and occasionally had difficulty in urination. Sometimes the wound in his leg caused him trouble, and he used crutches at the hospital.

The physical examination of his abdomen revealed very mild diffuse tenderness and an enlarged superficial vein in the suprapubic region. The principal pathologic conditions found were: Chronic myocarditis, degenerative; chronic bronchitis, associated with emphysema; moderate hypertension; general arteriosclerosis; chronic nephritis without edema, and a right inguinal adenitis.

The X-ray films showed the presence of a proliferative osteo-arthritis of the lower thoracic spine, apparently inactive.

The patient was discharged September 3, 1931, as not being in need of further hospitalization. From the foregoing description it may be noted that the coil could hardly bear any relationship to the patient's present pathologic condition.

Once it was established that the coil was fixed, it remained to be determined whether or not it was located within the gastric ventricle. In order to be able to take comparative measurements on the film, all of the exposure factors had to be identical. The film target distance was 27 inches. In the upright position the lower level of the coil was 6.6 cm. above the iliac crest, it being lodged on the left side near the vertebral column midway between the first and second lumbar vertebræ. In the prone position, it moved up to coincide with the area occupied by the first lumbar vertebra, but, in the vertical plane, the distance between it and the lumbar vertebræ remained stationary. Occasionally, in the prone position, the coil moved upward to a level between the first lumbar and twelfth thoracic vertebræ. Previously, it had been determined with the aid of a barium enema that the coil was not within the colon. In the lateral exposure it was 2.5 inches anterior to the vertebral column.

Inasmuch as it was almost certain that the coil must be within the gastric ventricle, a barium meal was given on several occasions. The patient was of the hypersthenic type, and the stomach of the horizontal variety. In standing posture, the lower pole of the stomach was 2.5 cm. above the iliac crest, moving up to a point 10.5 cm. above the iliac crest in the prone position. The pars media and the pylorus appeared narrow, but there was no defect in their contour. The pylorus opened at once, revealing a normal bulb and antrum. The patient complained of pain on pressure over the ensiform process, which point was above the pylorus. The coil was obscured by the barium in the standing, lateral, and prone positions. At the end of five hours the stomach was empty with the exception of a small amount of barium which was attached to the coil on the left side. The duodenum, including its second and third portions, did not exhibit the usual bend downward and to the left, but appeared to extend in an almost horizontal direction to the right. The fact that the coil moved upward sometimes to the level of the twelfth thoracic vertebra in the

prone position suggests that its movement depended on the position of the gastric ventricle at different intervals. Naturally the extent of the upward movement depended on the amount of gastric content present at the time of exposure. Inasmuch as the stomach was of the horizontal type, there was no definite dependent portion in which one might expect a foreign body to remain with the patient in the upright position. The measurements indicated that the coil was confined to the pars media; furthermore all of the films showed that it remained constantly in the same position and the configuration was always the same. It was also evident that the coil must be of a firm nature, since at no time did it change its shape. It appears to be about six to seven inches in length; the fluoroscopic and stereoscopic visualization of the coil is not sufficiently clear to allow of a more exact measurement, due to the patient's stocky build.

Having established the fact that the coil was within the stomach, it remained to be elicited how it got there. The only clue to this was the statement of the patient that he had had an examination by means of a stomach tube some twenty years earlier in a civilian hospital. The connection between this statement and the presence of the coil in the stomach must, of course, remain conjectural. But it is conceivable that the patient at that time retained a portion of the stomach tube, which may have been of a two-piece type, after it had become detached during its passage. It is also conceivable that the tube at once assumed a position in which it could not pass the pylorus. At this point it may be stated that the patient showed no abnormal retention of the gastric contents. In the course of time the coil may have assumed the shape shown in Figure 1, and have become almost petrified, through calcium deposits. The two open ends of the tube are plainly visible. Another circular opening within the complete loop, beneath the upper circular opening, would suggest a kinking of the tube at this point. Somewhat more difficult to explain is the constant position of the coil with reference to its distance from the vertebral column. It could not, of course, be adherent to the wall. Efforts to dislodge the coil were made difficult by the fact that the patient's stomach, which was of the hypersthenic type, as mentioned above, was placed high in the abdomen, being almost at the level of the costal arch.

If the patient ever comes to autopsy, there will be revealed a most unusual finding, the precise nature of which must until then remain largely speculative.

AN UNUSUAL FLUOROSCOPIC OBSERVATION

By DANIEL M. MOORE, M.D., Roentgenologist,
St. Francis Sanatorium, Monroe, La.

A careful review of the subject matter contained in the record of the case reported here has not been made, but the findings seem quite unique and well worth reporting. If anyone has made a similar observation, I would be glad to hear about it.

E. B., colored, age 48, according to the local newspapers, was shot on the evening of April 29, 1932, at the home of his "best friend." He rushed out of the house precipitately, not even taking time to open the gate, preferring to take the fence instead, two panels of which he tore out as he went over. He rushed to his own home about one block away, and the report was that he had to be held in bed until the ambulance arrived to take him to the hospital. He was hastily examined by G. M. Snellings, M.D., with J. G. Snellings, M.D., as consulting surgeon. An X-ray examination was requested. The patient appeared in fairly good condition except for a mild degree of shock, and was able to transfer himself easily from the ambulance cot to the fluoroscopic table.

A cursory examination revealed a puncture wound in the back over the eleventh rib approximately four inches from the spine. Thinking the bullet had probably entered the abdomen we carefully surveyed this part of the body under the fluoroscope, but found no evidence of the bullet or other changes from the normal. The diaphragm appeared smooth and regular and made free respiratory excursions, and no evidence of fluid in the thorax was noted. In the middle of the heart shadow was a density having the appearance of the leaden bullet, and it was doing all kinds of gymnastic stunts, toppling over and over from side to side very much as a ball in a fountain's stream of water, or a leaf in an eddy. This was observed for several moments during which time the patient stated that he was feeling very well; he appeared quite comfortable. We then had him turn on his left side for a few moments. The shadow still occupied the center of the stage ("the center of the stage" in this instance being the heart shadow), but suddenly dropped well down toward the apex of the heart approximately two inches from its original site, and then almost immediately shot upward to the posterior aspect of the base of the heart and lodged in a fixed position. No amount of turning or manipulation appeared to affect this position.

The first impression that we gained was that the bullet was in the blood stream within the heart chambers, but this seemed so utterly impossible or inconsistent in a living man that we abandoned it in favor of the pericardial sac. We assumed that the bullet was in contact with the auricle and was producing an auricular flutter, and when we changed the position of the patient it slipped downward and then upward in the sac and finally lodged in a neutral zone and the heart action quieted down to something like a normal rate. There was no appreciable amount of hemorrhage into the pericardium, fluoroscopically. Surgical removal of the bullet from the pericardium seemed indicated.

An hour later J. G. Snellings, M.D., opened the pericardium with the assistance of Dr. Jay W. Cummings. They found it filled with blood but were not able to locate the bullet, but, instead, found a rather large slit-like opening in the right ventricle which was leaking badly. Attempts to suture this opening were not successful and the man died on the table. I was present at the autopsy performed by C. P. Gray, M.D., Coroner. The bullet (a .38-caliber) was found lodged in the bifurcation of the left pulmonary artery.

SUMMARY

This case is of interest because of the following facts:

(1) A man with a bullet lodged in the chambers of his heart was able to run a city block, after tearing down a fence in his haste, and lived in apparent comfort for two hours.

(2) Three physicians were able to observe the antics of the bullet in the chamber of the heart before it finally lodged in the pulmonary artery.

EPITHELIAL POLYP OF THE LARYNX DEMONSTRATED BY THE ROENTGEN RAY

By W. H. McGEHEE, M.D., Instructor, Department of Radiology, University of Cincinnati

Considerable interest has been manifest during the last three years in the study of the neck in the lateral projection. Such studies have been stimulated by the original work of Brown and Reineke, in 1928, and later by the excellent monograph of Hayes. Careful review of the literature has failed to reveal any cases of polyp or papilloma of the larynx demonstrated by the roentgen

ray, with the exception of the single case in the Hayes publication. This lack of similar cases in the literature and the age of the patient to be presented, seem sufficient to justify this case report.

R. M. (Case No. R-2968), white male, age five years, entered the Cincinnati General Hospital complaining of loss of voice. The onset of the present illness began with hoarseness ten months before admission. The hoarseness grew progressively worse until the child could not speak above a hoarse whisper. There had been no obstruction to breathing, only occasional choking on swallowing. The past history was irrelevant. General physical examination was essentially negative.

Roentgen study (lateral view of the neck) showed a tumor mass, approximately 0.5 cm. in diameter, arising from the larynx at the level of the fourth cervical vertebra. The laryngeal ventricle was not demonstrated. It was assumed that the tumor was encroaching on the vocal cords. Impression: Polyp of the larynx.

Direct laryngoscopic examination disclosed a growth about the size of a pea, situated in the anterior commissure, hanging between the vocal cords. The cords were reddened and thickened.

Fig. 1. Roentgenogram made in right lateral projection. There is a small tumor mass arising from the anterior wall of the larynx at the level of the fourth cervical vertebra.

At operation the clinical and roentgen findings were confirmed. The voice was definitely improved when the child was discharged.

EDITORIAL

LEON J. MENVILLE, M.D. . . . . . *Editor*
BUNDY ALLEN, M.D. . . . *Associate Editor*

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THE CO-OPERATION OF THE LABORATORY WITH THE HOSPITAL TUMOR CLINIC

The treatment of patients with malignant newgrowths and the investigation of the causes of this condition are among the largest and most important tasks confronting medicine to-day. Unfortunately, I can add nothing new to the subject. My part in the program is to describe briefly, in terms of the organization of our own institution, our conception of the manner in which our laboratories co-operate with the newly established tumor clinic, to point out how we can be of assistance to this special group in research, and then to mention briefly a few lines of investigation which might be profitable.

Ours is a general hospital, mainly for acute illnesses, of about 600 beds. We have a large pavilion for children, ward service, and service for private patients. The various specialties are well organized; in addition, there are study groups made up of interested clinicians from the various services, as well as representatives from the laboratory. Several of these special groups, which have an endowment for research, have full-time representatives in the laboratory. These men are members of the laboratory staff, being responsible to the Director of Laboratories and the Research Committee, as well as to their own special study group. This interlocking system, which has been functioning satisfactorily for several years, is, we believe, producing results.

The problems which appeal to all of us at the hospital are related to clinical medicine. This does not mean that our investigations are those of applied research only. On the contrary, it is our hope that many of the investigations are fundamental in character. They are all investigations, either of the clinical material and of ideas suggested by the clinical work, or else into experimental fields originating from either of the two sources just mentioned. Should we be fortunate enough to accomplish something in experimental investigation, we expect to follow this to a certain limited extent, but not indefinitely. If something worth while is found, the results will be published so that other institutions devoting themselves entirely to pure research may follow if they wish, leaving our group free to return to their problems of the type for which we have special facilities.

Not only do we co-operate with clinicians in the way just described, but we encourage clinicians to come with their ideas to our laboratories to start work, giving them all the facilities and assistance we can. By having many of our clinicians at work on their own investigations, we have made progress which we believe is in the right direction, but we are now close to our limit of space and funds for this important phase of our institutional life.

There is no originality claimed for this organization—undoubtedly it is being carried on in a similar way in many institutions. We do believe that the spirit of co-operation between the laboratory and clinical groups is genuine, and we are really at work hoping to accomplish some of our ambitions.

In an organization such as we have, it was very simple to organize an additional group, the tumor clinic group. Our pathology department was well organized with its own department head, before the inception of the tumor clinic. For years it has been our practice to have all material removed in the operating room examined grossly and microscopically by the pathologist. Diagnoses are returned routinely in from two to three days, and they can be returned in less than 24 hours. In addition, for a number of years, our pathologist has made frozen sections in one of the rooms of the operating suite, giving his diagnosis to the surgeon in from three to five minutes after receiving the specimen. We are willing to make a definite diagnosis in more than 95 per cent of the specimens. When a definite diagnosis has been made from frozen sections, it is practically never necessary to change the diagnosis in any essential way from a later study of the permanent sections. It should not be understood from this that we believe that we are always correct in our frozen section or any other kind of diagnosis. However, it does mean that we have just as much chance of being right or wrong, when we make definite diagnoses from frozen sections as we have from the finished sections. Even in the small percentage of instances in which we cannot make a definite diagnosis, our pathologist's opinion frequently is of help to the surgeon.

We now have another experienced pathologist in the Director of our tumor clinic, who is welcomed by our hospital pathologist in studying the frozen sections, as well as all other material. Thus, we are now able to study to the limit of our facilities not only the histogenesis of tumors and their mode of dissemination, but also characteristics of unusual tumors, the effect of various procedures on tumors, the grading of malignancy, radiosensitivity, and other factors of interest.

Our clinical laboratories have always followed blood changes, which, to a certain extent, act as aids to guide special workers in radiotherapy in the amount of radiation to be used, the reaction of the patient, etc. Our chemical laboratory, with its own department head, can furnish a limited number of blood chemical determinations, and the bacteriologic and serologic division, with its separate department head, can furnish cooperation in its special field to a limited extent. The metabolism department may be an important factor in studying malignant disease. Our necropsy department is a definite aid in observing the end-results of neoplasms and furnishes somewhat of a check of the results of therapy, whether this is by surgery, radiation, or other means.

It requires considerable funds to furnish the tumor clinic with all of the laboratory co-operation it should have. Since investigations of this type require many specially trained workers, generous amounts of laboratory space, animal facilities, etc., additional, very sizable funds are needed everywhere for "cancer research." Every tumor clinic should have adequate research facilities, as each one of these special groups undoubtedly has many important problems for investigation and will develop still more with the work of its department.

So many outstanding individuals are at work, trying to solve the problem of the cause or causes of cancer, that it is with considerable reticence that I suggest a few possible fields of study which might be profitable.

More knowledge is needed of the biology of malignant growths, and, to understand this, knowledge must first be established of the biology of normal tissue growth. Carrel, Fisher, and others have made important contributions in this field. The metabolism of malignant tissues must be studied, and here Warburg and others have made important advances.

The effect of general measures, such as sunlight, vitamins, etc., demands study, for,

as emphasized by Yates and others, malignant tissue itself spreads in somewhat the same way as various bacterial infections. (This does not mean that the cause of malignancy is considered to be an infectious organism but merely that the spread of malignant disease along lymphatics and tissue planes is similar to the spread of some infections.) Since selected general measures are of therapeutic value in the management of infections, certain of these should be considered as having value in the treatment of malignant disease.

More investigation is needed of the possibilities of radiotherapy, its accurate control, its limitations, etc. More study is needed of the manner in which radiation, in therapeutic doses, influences deep-seated tumors. Does it produce its effect by direct action on the malignant cells, or indirectly through the non-malignant tissue cells and fluids of the body? There is still a difference of opinion about this.

More investigation is needed of the value of radiotherapy immediately after operations for such conditions as carcinoma of the breast, uterus, ovary, etc. It is my understanding that, at present, there is no clear-cut knowledge of the value of post-operative radiation to prevent recurrences, as, for example, in mammary cancer. The necessity of learning more about the results of such treatment has been brought out recently in a number of articles. Important considerations include: accurate study, by the same experienced pathologist, of breast carcinomas in a large series of patients; the performance of the same type of operation by the same surgeon or a small group of surgeons; the accurate following of the patients after operation, whether roentgenotherapy has been used or not, and the keeping of accurate records of all patients. In order to gain much needed knowledge, it seems to me important that several large series of cases, treated alternately, should be followed. Since there is skepticism among many of the value of this type of post-operative therapy, a control series of this sort is justified. Only with such a control series will skepticism give way to definite knowledge.

Most important of all must be the attitude that no idea or theory dealing with the possible cause or treatment of malignancy should be discarded because of any *a priori* reasoning. In the midst of our ignorance, every logical idea must be given serious consideration.

Attempts, such as those of Lumsden and others, to build up specific immunity against neoplastic disease, are worthy of trial and experimentation. The search should be continued for a substance with a special affinity for attaching itself to living malignant cells, preferably a substance which will make these cells radiosensitive. A tremendous advance will be made if such a substance can be found. This would increase the directness of our attack on malignant cells with radiation. The chemist might be able to attach to the molecules of such a substance chemical groups which would have a toxic action on malignant cells. Chemical groups staining the malignant cells in a selective manner might be attached to this substance, allowing us to make a diagnosis much earlier than we can at present. Dr. Bloodgood and his group are working in this direction. Fluorescence might be added to the substance with this special affinity for neoplastic cells, which again would allow for earlier diagnosis.

The idea that the real cause of malignant tumors might be an infectious agent should still be borne in mind, for this possibility has not yet been disproved.

If this summary has given you a clear idea of our efforts, it will have accomplished its purpose.

WILLIAM THALHIMER, M.D.

Michael Reese Hospital
Chicago, Illinois

COMMUNICATIONS

SYMPOSIUM ON THE X-RAY

This Symposium was a joint program between the Zoölogical, Chemical, and Medical Sections of the American Association for the Advancement of Science, the American Roentgen Ray Society, the Botanical Society of America, the American Society of Bacteriologists, and the Northwestern New York Division of the American Chemical Society. It was one of several symposia held as part of the Summer Meeting of the American Association for the Advancement of Science, June 20-25, 1932. The following papers were presented:

1. "Differential Action of X-rays and its Bearing on Cancer Therapy,"
   G. Failla, D.Sc., Director Radiological Research, Memorial Hospital, New York City
2. "Effect of X-rays on Germ Cells and Heredity,"
   James W. Mavor, Ph.D., Director, Department of Biology, Union College, Schenectady, N. Y.
3. "The Significance of Proper Physical Measurements in Interpreting the Biological Action of X-rays,"
   Lauriston S. Taylor, Bureau of Standards, Washington, D. C.
4. "Clinical Observations on the Relative Value of Radium and X-rays,"
   Douglas Quick, M.D., Memorial Hospital, New York City
5. "Changes Following X-ray Treatment of Newgrowths,"
   R. E. Herendeen, M.D., Memorial Hospital, New York City
6. "The Quantitative Evaluation of the Effects of X-rays on Cells of Different Sizes,"
   R. W. G. Wyckoff, Ph.D., Rockefeller Institute for Medical Research, New York City
7. "Some Quantum Calculations on the Lethal Effect of X-rays,"
   Wheeler P. Davey, Ph.D., Professor of Physical Chemistry, Pennsylvania State College
8. "On the Nature of the Action of X-rays on Living Tissues (Blood-forming Cells),"
   Raphael Isaacs, M.D., Asst. Director of Thomas Henry Simpson Memorial Institute for Medical Research, Ann Arbor, Mich.
9. "The Death of Yeast Cells by X-rays," Otto Rahn, Ph.D., and M. N. Barnes, Department of Bacteriology, Cornell University, Ithaca, N. Y.
10. "The Chemical Effects Produced by X-rays on Aqueous Solutions,"
    Hugo Fricke, Ph.D., Department of Biophysics, Long Island Biological Association.
11. "Some Physiological and Genetic Effects of Grenz Rays,"
    T. H. Goodspeed, Ph.D., University of California
12. "The Effect of X-rays on Tumors in Animals Treated by the Heublein Method,"
    Halsey J. Bagg, Ph.D., Memorial Hospital, New York

MEDICAL SOCIETY OF THE STATE OF NEW YORK

At the 126th Annual Meeting of the Medical Society of the State of New York, held in Buffalo, N. Y., Tuesday, May 24, 1932, the first Session on Radiology was given. The program was as follows:

1. "The Accessory Nasal Sinuses in Scarlet Fever,"
   Donald S. Childs, M.D., Syracuse
2. "Structural Changes of the Aorta Due to Arteriosclerosis as Observed Roentgenologically," Lantern Slide Demonstration,
   Joseph H. Green, M.D., Rochester

3. "The Correlation of Roentgenological Findings and Pathological Specimens of Gastric Cancers and Ulcers with their Differentiation,"
   LEWIS G. COLE, M.D., New York City
4. "The X-ray as an Aid in the Early Recognition of Serious Disease of the Colon,"
   W. H. STEWART, M.D., and
   H. EARL ILLICK, M.D., New York City
5. "Chronic Duodenal Stasis,"
   ROSS GOLDEN, M.D., New York City
6. "Scope and Application of Radiation Therapy,"
   DOUGLAS QUICK, M.D., New York City
7. "Some X-ray Evidences of Intracranial Pathology,"
   CHARLES W. SCHWARTZ, M.D., New York City
8. "X-ray Findings in the Diagnosis and Treatment of Pulmonary Tuberculosis" (Lantern Slide Demonstration),
   OSWALD R. JONES, M.D., New York City

LETTERS TO THE EDITOR

May 10, 1932.

Editor of RADIOLOGY: May I have the use of your column to make the following brief remarks in reference to a statement appearing in "Roentgenologic Exploration of the Mucosa of the Gastro-intestinal Tract," of your February issue (page 230)?

At the time of my publication of "Roentgen Studies of the Mucosa in the Normal and Pathologic State" (*Am. Jour. Roentgenol. and Rad. Ther.*, July, 1923, X, 526–537) the work of Dr. von Elischer was unknown to me. It is true that the methods of examination were very similar; however, the purposes of these investigations were entirely different. Notwithstanding this fact, I felt that the lack of reference to von Elischer's work was an injustice and, as soon as it came to my attention, I wrote to him apologizing and at the same time acknowledged his priority in the work. It is unfortunate, however, that I cannot substantiate the senior collaborator's statement concerning his early use of the mucosal study. Neither any member of my class at the Army Training School nor I can recall Dr. Cole's method of sedimentation or any reference by him to the diagnosis of gastro-intestinal pathology by study of the mucosa.

Sincerely yours,
RICHARD A. RENDICH, M.D.

116 Remsen Street
Brooklyn, N. Y.

REPLY

May 26, 1932.

In reply to Doctor Rendich's comment, I would state that, for the Army Training School, I used the same curriculum and same group of slides which, as Professor of Radiology of the Cornell Medical School, I had used previously for the instruction of undergraduate students. I have retained the lantern slides which were used for both of these classes, and two of these slides, showing early mucosal technic, are identical with the illustrations in RADIOLOGY. I am sorry that my instruction was so unimpressive.

Sincerely yours,
LEWIS GREGORY COLE, M.D.

36 East 61st Street
New York, N. Y.

NOTE

Readers will note the omission of Abstracts of Current Literature from this issue. This does not indicate a future policy or any lack of material. It is an emergency measure necessary, we hope, this month only.